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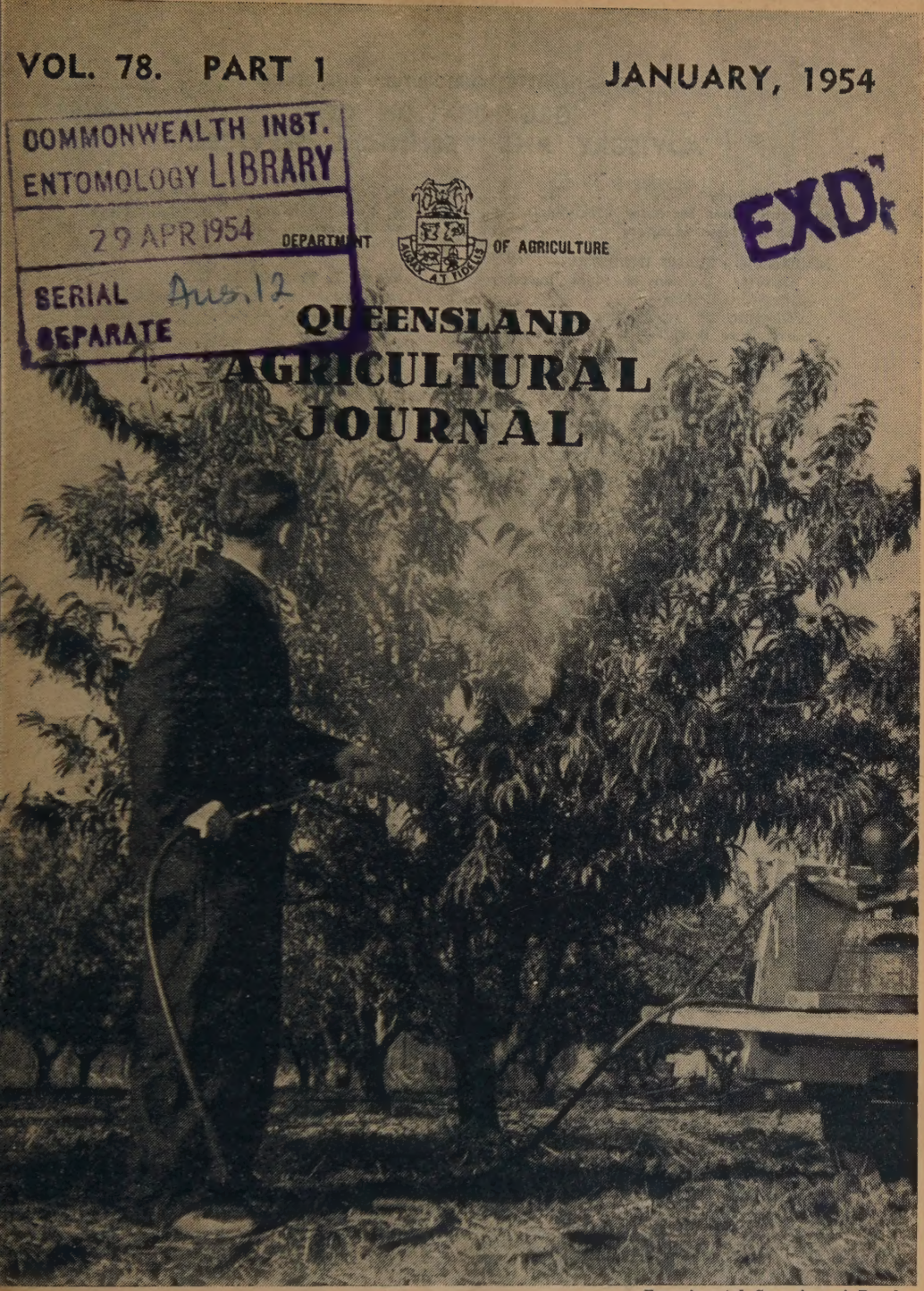

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Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain "St. Christopher's" and "Iona" Studs, Brookfield road, Brisbane E. Mathie and Son, "Ainslie" Ayrshire Stud, Maleny C. E. R. Dudgeon, "Marionville" Ayrshire Stud, Landsborough
Friesian	C. H. Naumann, "Yarrabine" Stud, Yarraman
Guernsey	C. D. Holmes, "Springview," Yarraman A. B. Fletcher, Cossart Vale, Boonah W. H. Doss, Degilbo, *via* Biggenden
Jersey	Queensland Agricultural High School and College, Lawes J. S. McCarthy, "Glen Erin" Jersey Stud, Greenmount J. F. Lau, "Rosallen" Jersey Stud, Goombungee G. Harley, Hopewell, M.S. 189, Kingaroy Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley R. J. Crawford, "Inverlaw" Jersey Stud, Inverlaw, Kingaroy P. H. F. Gregory, "Carlton," Rosevale, *via* Rosewood E. A. Matthews, "Yarradale," Yarraman A. L. Semgreen, "Tecoma," Coolabunia G. & V. Beattie, "Beauvern," Antigua, Maryborough L. E. Meier, "Ardath" Stud, Boonah A. M. and L. J. Noone, "Winbirra" Stud, Mt. Esk Pocket, Esk W. S. Conochie and Sons, "Brookland" Stud, Sherwood road, Sherwood Estate of J. A. Scott, "Kiaora," Manumbar road, Nanango F. W. Verrall, "Coleburn," Walloon C. Beckingham, Trouts road, Everton Park W. E. O. Meier and Son, "Kingsford" Stud, Alberton, *via* Yatala G. H. Ralph, "Ryecombe," Ravensbourne Mrs. I. L. M. Borchert, "Willowbank" Jersey Stud, Kingaroy W. and C. E. Tudor, "Boree" Jersey Stud, M.S. 498, Gayndah C. A. Edwards, "Grasmere" Jersey Stud, Woodford Weldon Bros., "Gleneden" Jersey Stud, Upper Yarraman D. R. Hutton, "Bellgarth," Cunningham, *via* Warwick
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Establishing Lucerne.

J. L. GROOM (Agronomist) and E. C. DARLEY (formerly Assistant Agronomist), Agriculture Branch.

CLIMATIC REQUIREMENTS.

The best growth of lucerne is obtained in areas with a temperate or a warm-temperate climate, but the crop has been grown successfully well into the tropics.

Lucerne cultivation is most successful on suitable soils in regions where rainfall is low enough to eliminate serious losses of crops cut for hay, and where irrigation can be applied to supply adequate soil moisture. There are some areas in Queensland, however, where excellent lucerne can be grown without irrigation on well-drained fertile soils in which the water-table (the level of permanent water in the soil) is well within reach of the deeply penetrating root system.

Plate 1.

A Two-Year-Old Stand of Lucerne, Hermitage Regional Experiment Station. The crop is on a black soil slope typical of the eastern Darling Downs. No irrigation is practised.

Although lucerne growing in Queensland is largely confined to the country extending 200 miles inland from the coast between the Tropic of Capricorn and the southern border of the State, it is known that good lucerne crops can be grown in areas outside these limits, especially under irrigation. Without irrigation it is doubtful if lucerne growing will be satisfactory in districts with an annual rainfall of less than 25 in., despite the capacity of the root system of the plant to penetrate deeply for subsoil moisture. On the other hand, excessive rainfall, especially where drainage is deficient, is detrimental and lucerne will die out quickly under such conditions.

Good stands of lucerne have been grown with supplementary irrigation as far north as Mount Garnet and the Atherton Tableland. On Kairi Regional Experiment Station on the Atherton Tableland, where the average annual rainfall is about 60 in., successful crops have been grown for several years with supplementary irrigation on a deep, well-drained, friable, well-structured, red-brown clay. On Wrotham Park Exploratory Farm, 55 miles north-west of Chillagoe, lucerne plantings have been established during the summer rainy season, but the seedlings died out in the hot, dry autumn months in the absence of irrigation. It is believed that on well-drained, fertile soils, lucerne could be grown satisfactorily even as far north as represented by this location.

Plate 2.

Non-irrigated Lucerne on a Flat Near the Dumaresq River, Texas District.
The soil is a dark grey clay loam overlying a dark grey silty clay loam.

Plate 3.

A Patch of Irrigated Lucerne in the Gilbert River District, North Queensland.

It is clear, therefore, that the lucerne plant can adapt itself to a wide range of climatic conditions and could be grown in most districts in Queensland, provided soil and water requirements could be met.

In the main lucerne-growing areas of Queensland, winter temperatures are usually low enough to check the rate of growth but not to prevent it, unless soil moisture is insufficient for growth. From yield data compiled over several seasons from an irrigated lucerne field at the Bureau of Investigation's Irrigation Research Station at Gatton, slow growth and light cuts of hay are typical of the cool months May to September inclusive. Growth usually accelerates sharply in October and may reach the peak growth rate of the season in that month and in early November. Thereafter a good growth rate is maintained until late April, when it slows down with the onset of cooler weather. Good hay is frequently made from irrigated lucerne in the autumn months, when growth of summer weeds has declined and weather is often very suitable for haymaking.

In areas where irrigation is not practised, the availability of soil moisture is of paramount importance, and the extent of lucerne growth is more closely linked with this factor than with temperature. In general, however, growth, as is the case with irrigated lucerne, is most prolific during the summer months.

SOIL REQUIREMENTS.

For best growth, lucerne requires a soil of high fertility which is deep and well drained. Good drainage is essential, as lucerne is very sensitive to waterlogging, which results in surface ponding of water.

Although a first class soil is required to produce best growth with lucerne, payable crops can be grown with varying degrees of success on a wide range of soils. Soil amendments and fertilizers may be necessary to stimulate growth, but grazing stands or mixtures with grasses are well worth trial in all districts with an average annual rainfall of 25 in. or more. Irrigated lucerne, of course, could be produced over a much wider area than this, with adequate supplies of water.

Soils in which lucerne thrives are usually well supplied with calcium and phosphorus. For best results, lucerne soils should be neutral in reaction. Strongly acid soils may therefore require lime applications before good lucerne stands can be established, and in phosphorus-deficient types applications of superphosphate are advisable.

Also of importance from a soil deficiency aspect are potassium and sulphur, as lucerne requires large quantities of these plant foods. Each crop of hay removes a considerable amount of potassium and other nutrients, and constant cropping with lucerne on soils low in available potassium and other minerals may result in deficiency symptoms appearing. In the case of lucerne, potash deficiency shows as a regular pattern of white dots in a crescent near the leaf margin. This deficiency has been observed frequently in fields along the Laidley Valley, particularly in well-established stands irrigated for hay production.

Plate 4.

Sulphur Deficiency Limits the Growth of Lucerne on Some Soils. The portion of the stand on the left has received no sulphur and is heavily invaded by grass. The portion on the right has been treated with a fertilizer containing sulphur.

Unthrifty lucerne growth may appear on soils not well supplied with sulphur (Plate 4). This element is required for the production of proteins, and as these proteins are removed in the hay, there is a gradual decline in the amount of sulphur available in the soil. Sulphur may also be required for the proper functioning of the bacteria in the root nodules. Symptoms of sulphur deficiency are thus likely to appear in old lucerne stands used

for hay production. They are manifested by a general lack of vigour and a pale yellowish-green colour of the foliage. Sulphur deficiency has been observed in the alluvial soils of the Lockyer Valley, around Beaudesert in the Logan Valley, and at Theodore in the Dawson Valley. It has been suspected elsewhere also, including districts on the Darling Downs. Superphosphate contains an appreciable percentage of sulphur, and growth responses to applications of this fertilizer may be due to the sulphur rather than the phosphorus content.

As the lucerne plant, like legumes in general, obtains most of its nitrogen requirements from the air as a result of the activities of bacteria which are located in nodules on the roots, it is unnecessary that land for lucerne should be rich in this plant food or that nitrogenous fertilizers should be applied. Instances have been reported of a growth response by lucerne to ammonium sulphate applications, but it is not unlikely that the response is due to the sulphur content of the fertilizer.

Some investigations with trace elements have been carried out in the major lucerne-growing districts, but the chief indication has been that boron may be deficient in the soil in some localities. Symptoms of boron deficiency are indicated by the stunted growth of the plant tips. The young leaves are very yellow and the internodes of the growing points are very short. Sometimes bright colours in the lower leaves are also associated. The simplest remedy is to apply a small quantity of borax (25 lb. per acre). Usually one application will suffice for the life of the stand. The material is best applied shortly after a cut, and preferably at the time of maximum growth in the warmer months of the year.

Where a soil deficiency is suspected, the grower should consult the nearest Adviser in Agriculture. Analytical data for a wide range of soils are available from the Chemical Laboratory of the Department of Agriculture and Stock, and a grower's queries on major soil deficiencies can probably be answered without soil sampling. If not, directions for obtaining a representative soil sample will be supplied, and the necessary analysis will be done. In certain cases, actual field tests are advisable to supplement the soil analytical data. Growers are advised to set out small observation plots with fertilizers for this purpose before applying fertilizers on a large area.

VARIETIES.

Many different varieties occur, but for practical purposes the cultivated lucernes of the world can be divided into two main classes, namely, the variegated or " hardy " varieties of hybrid origin and the non-variegated, " non-hardy " or common varieties.

The variegated varieties have flowers of various colours and buried crowns, and are capable of withstanding extremely low temperatures. In general, they are inferior to the common variety which is grown in Australia and they are not cultivated in Queensland.

The Australian lucerne is included in the common or " non-hardy " group and so far has given a superior performance to imported varieties; hence growers should purchase seed of Australian lucerne strains only. The principal strains recognised by the seed trade are Hunter River, Tamworth and Mudgee. There appears to be little difference between these strains for all practical purposes.

Australian lucerne is very uniform. This is not surprising in view of the fact that over many generations natural selection has resulted in the elimination of unsuitable types, leaving only those strains which are adapted to local conditions. These strains are perennial in habit, have violet-coloured flowers (typical of the common or non-variegated varieties) and bear a large number of erect, leafy, sparsely branched stems which arise from a crown at or above ground level.

INOCULATION OF SEED.

Lucerne is a leguminous plant and so requires the presence of certain bacteria in the soil to foster its maximum development. These bacteria invade the roots of the crop, form the well-known nodules and produce a simple soluble protein which becomes available to the plant. This protein constitutes the lucerne's source of supply of nitrogen. Areas in which burr medic and other close relatives of lucerne are not normally found may be deficient in the specific strain of desirable bacteria, and this deficiency must be remedied if lucerne is to flourish.

The age-old method of overcoming this problem was to distribute soil from an old lucerne field over the new field to be sown to lucerne. However, the easiest and most efficient method of ensuring the presence of these bacteria in the soil is to treat the seed with inoculum. This may be obtained by writing to the Department of Agriculture and Stock, Brisbane, requesting lucerne inoculum, and stating the amount of seed to be treated. A pure culture of the bacteria, growing on a jelly-like substance in a bottle, will then be forwarded with full instructions for its use. These cultures will retain their vitality for several weeks if stored according to the accompanying directions.

The inoculum is supplied free. Therefore, if there is the least doubt that the correct bacteria for lucerne are present, farmers are recommended to apply for it.

ESTABLISHING THE CROP.

Land Preparation.

Thorough preparation of the land is needed for lucerne to produce a firm seedbed, free as practicable of weeds and with good supplies of subsoil moisture. Excessive weed growth in the young stand can be a serious handicap and a grower cannot afford to neglect land preparation.

Virgin land should not be used for lucerne, nor is it advisable to plant lucerne as the first crop after ploughing up grassland, whether the crop is to be irrigated or rain-grown. The usual practice is to sow lucerne after several cultivated annual crops, when the land will be brought into a condition more favourable for a lucerne crop.

Because lucerne is a perennial crop, lasting several years, it is very desirable to provide the best possible conditions for its establishment.

The stubbles from the preceding crop should be ploughed under in December or January at the latest. This first ploughing need not be very deep, three to four inches being sufficient to cut through the crowns of the stubble and to present a rough surface to trap rain. After rain, when buried portions of the stubble have commenced to rot and weeds have appeared, a second ploughing, slightly deeper than the first, should be carried out. On alluvial soils of the irrigation areas, this second ploughing may be as deep as eight inches.

Following subsequent rains, tine cultivators should be employed to destroy all weed growth and to settle down the soil, unless the surface is still sufficiently cloddy to require further breaking with a disc cultivator. Excessive use of disc cultivating implements should be carefully avoided at all stages, owing to their pulverising effect and to the fact that they tend to work too deeply and thereby dry out the surface soil.

The final seedbed should be compact and as shallow as the soil type and implements will permit.

Under dryland conditions, failure is often experienced in trying to re-establish lucerne on land that has not been long out of lucerne. The prime reason for this failure appears to be the marked depletion of the subsoil moisture by the previous lucerne stand, as lucerne has a much higher moisture consumption than other crops and must draw upon subsoil moisture to fulfil its requirements. This is also of importance in a lucerne-wheat rotation.

Time of Sowing.

April and May are the best months for sowing in those areas of Queensland where sufficient rains to ensure good germination can be expected. At this time of the year the subsoil should contain ample supplies of moisture if a sufficiently long fallow has been given. Sowing in these months minimises the risk of severe weed competition in the young stands. Moreover, the slow shoot growth during winter favours development of the framework of the extensive root system which is so essential for long life of the stand and good yields of hay.

Spring plantings, though often quite successful under irrigated conditions, do not foster early development of the root system, and are likely also to suffer from the disadvantages of unreliable rainfall and weed competition. However, sowing in spring, early summer or early autumn may be justified where winter rains are very unreliable. This is particularly so where sowing in a mixture with grasses is being considered.

Rate of Sowing.

Under conditions of good rainfall or where irrigation is practised, a sowing of 9 lb. per acre is sufficient when using a seed drill, 10–11 lb. if broadcasting by machine and, if sowing by hand, up to 13 lb. or 14 lb. per acre may be used to avoid a patchy strike. Under normal circumstances heavier sowings do not appear to be justified and represent a waste of valuable seed.

In the lower rainfall areas, high seeding rates are unnecessary and may actually be harmful to the young stand ; if a good strike is obtained, subsequent natural thinning out during periods of soil moisture shortage may be excessive, resulting in a very patchy stand which will become infested with weeds unless oversown with grass.

In such areas seeding rates from 1 lb. to 4 lb. per acre are sufficient, the actual rate being determined by the condition of the seedbed and climatic conditions at planting ; under favourable conditions for germination and early establishment, seeding rates may be reduced.

Rates as low as half a pound per acre are satisfactory in pasture mixtures.

Methods of Sowing.

Lucerne seed is best sown immediately after rain to ensure quick germination. Good soil moisture also permits the nodule bacteria to persist and enter the root hairs of the primary root at an early stage in the plant's growth.

Quick germination is important. To achieve this, drilling in the seed is the best method of sowing. It also results in a considerable saving of seed, for with broadcast sowings it is generally necessary to increase the seeding rate by at least half as much again.

The seed should be drilled into the moist soil, and as a rule should not be placed deeper than $1\frac{1}{2}$ in., though good germination is possible at 2 in. Shallow planting ($\frac{1}{2}$–1 in. deep) is normal where the seedbed can be irrigated.

The wheat drill or combine may be used very successfully for drilling in the seed, especially if it is fitted with a small-seeds box.

If this small-seeds box is not available, the seed may be mixed with fine sawdust, rice hulls or similar material and sown through the grain box, or mixed, immediately before planting, with superphosphate, lime, sand or fine dry soil and planted through the fertilizer box. Superphosphate, however, will destroy the nodule bacteria on inoculated seed. After drilling, a light rolling to compact the soil around the seed is desirable.

When broadcasting, it is best to sow half the seed in one direction, and the rest at right angles to the first to obtain a more even spread. Inoculated seed should not be left exposed to the sun for any great period, and it is best to cover the seed by harrowing as soon as possible after broadcasting.

Quite commonly, in the wheat areas, where sheep are also kept, lucerne seed is mixed with the seed wheat and the mixture drilled in at the normal wheat planting time. After harvest of the wheat grain the lucerne is allowed to grow for a month or so without grazing. The resultant stand can then be used for continuous grazing for some years until other areas have been seeded to lucerne. The grazed area is then brought back into cultivation for wheat production.

A wheat-lucerne rotation practice can do much to maintain soil fertility in the grain-growing areas. It assists in the control of wild oats, and provides an area of safe feeding which helps to stabilise stock production.

Grazing stands of lucerne used continuously do not appear to cause any serious trouble from bloat. If they are well managed, such stands are capable of providing long-season grazing for seven years or more.

Harvesting Green Panic Seed.

J. G. J. STEVENS, Manager, Biloela Regional Experiment Station.

Green panic (*Panicum maximum* var. *trichoglume*) is adaptable to a wide range of soil types and is now a very important pasture species in Queensland.

Seed supplies are frequently limited, however, and the viability of the seed is so notoriously low that the prescribed minimum germination has been fixed at 3%.

The inferior quality of seed samples can be related to the seed setting and ripening characteristics of this species. The maturation period may be spread over 10 to 14 days and seed ripening occurs progressively from the top to the bottom of the loose spreading panicle and from the tips of the lateral branches towards the centre. In order to avoid loss of grain, which falls readily when ripe, harvesting is generally done before the seed is mature and the resultant sample is of poor quality. Fortunately, the viability of green panic seed has been shown to improve with storage for up to 10 months.

Harvesting Methods.

The problem of harvesting green panic seed and the quality of the resultant samples has been examined by the staff of the Biloela Regional Experiment Station and some of the observations are of particular current importance.

During 1952 a tall stand of green panic was harvested by six methods, namely—

(1) Heading with " Case " All Crop harvester.

(2) Pick up with " Case " (mowing and threshing).

(3) Old binder with knife and comb removed and reel speeded up 100%.

(4) Gauze frame on front of tractor.

(5) Binder—stooking and later stationary threshing.

(6) Hand collection.

In methods (2) and (5) the grass was cut and allowed to cure in the field for several days before threshing. In some seasons excessive losses would occur by weathering. Yield of seed by these methods was 17 lb. and 79 lb. per acre respectively, and the multiplicity of operations would increase harvesting costs.

Treatments (3) and (4) were effective in obtaining good samples, as the harvest was obtained by knocking the heads to dislodge ripe seeds, which were collected on the platform of the old binder or in a container under the gauze frame on the tractor. Some speed of operation was necessary and several harvests would be required to obtain a reasonable yield of mature grain. In three successive collections on two areas, yields of 18 lb. and 23 lb. of seed per acre were obtained by using a reinforced gauze frame (Plate 1) on the front of a Farmall A tractor, and 46 lb. and 50 lb. per acre were collected by using a binder with the comb and knife removed and the reel speed doubled. These two methods, though giving good samples, require multiple operations, and the occurrence of winds or rain could result in shedding of seed before collection.

Harvesting with the " Case " All Crop harvester gave a yield of 79 lb. per acre, but the time of harvesting must be carefully selected and the seed requires drying before storage.

Plate 1.

Harvesting Green Panic Seed with a Frame Attached to a Utility Truck.

Biloela Regional Experiment Station.

Hand collection by shaking the heads into a suitable container gave very satisfactory yields of 105 lb. per acre of mature seed after four collections, and this procedure would still be most practical on undulating or timbered country, particularly where a farmer collects his own seed requirements.

In 1953 a special experimental stripper was used to harvest green panic seed, the operation being similar to the wheat stripper employed before the advent of the header-harvester. This machine was economical in operation and harvested a large quantity of seed quickly, but for satisfactory results the seed required immediate drying before storage.

Viability of Seed.

Green panic seed samples of high quality have shown a very low percentage of germination for at least two or three months after harvesting, when a gradual improvement has been observed for up to 10 months. Longer storage did not cause any deterioration of seed.

Samples of seed collected by hand shaking and by a screen fitted to the front of a tractor in March 1951 were tested for percentage germination on eight occasions during a storage period of 20 months. Results are shown in Table 1.

TABLE 1.

Germination of Hand-harvested and Machine-harvested Seed.

Date of Germination Test.	Germination Percentage, Hand-harvested Seed.	Germination Percentage, Screen-harvested Seed.
9–4–51	8	9
31–5–51	30	16
19–7–51	34	30
13–9–51	49	53
10–10–51	68	65
2–1–52	78	71
25–2–52	68	80
23–10–52	71	81

Experimental work has shown that the quality of seed obtained by cutting the grass with a binder, and later threshing by use of a pick-up harvester, has not shown any improvement with storage. It is considered that the exposure of the maturing seedheads to weather conditions has been detrimental, and of course, considerable amounts of the more mature seed would be lost during handling and threshing.

Conclusions.

It has been shown that the best quality green panic seed is produced by hand shaking, by using a binder with the knife and comb removed and the reel speeded up, or by using a screen fitted to the front of a vehicle which dislodges mature seed into a suitable receptacle.

For harvesting large areas, the " Case " All Crop harvester and the stripper are satisfactory, but considerable care is necessary to determine the time of operation. The seed should be well formed and changing from green to yellow colour, and when ready for harvesting a few seeds can be dislodged by shaking the panicles. Seed obtained by straight heading should be speedily dried after harvesting before storage, as the presence of immature seed causes rapid heating and deterioration of the lot. Seed harvested by this method was tested three and six months after collection and showed germination of only 4% and 13% respectively. Longer storage may have resulted in a higher percentage of viable seed.

Sown Pastures for Sandy Soils in South-Eastern Queensland.

N. F. FOX, Assistant Agrostologist, Agriculture Branch.

The dominant pasture species on the sandstone ridges of south-eastern Queensland are native grasses of low productivity. This is particularly true in the basin of the Brisbane River and its tributaries, where extensive areas of poor sandy soils exist in close proximity to highly productive alluvials.

Closer to the coast, where rainfall is higher, overgrazing has led to the replacement of native pastures by blue couch, which makes little growth in the summer months and frosts badly in winter.

Because of inherent low fertility and topography which in many cases renders them liable to erosion, these soils are not capable of sustaining continued cropping. Their efficient utilization therefore is dependent on the establishment and maintenance of productive pasture mixtures.

Plate 1.

An Improved Sown Pasture in the Brisbane District. The pasture consists of green panic, lucerne and phasey bean. The slope in the background carries blue couch and blady grass.

Pasture Mixtures.

Trials have shown that Rhodes grass, green panic, buffel grass and molasses grass will produce well on these soils. Rhodes grass generally is not as palatable to stock as the other species. Lucerne and phasey bean (*Phaseolus lathyroides*) are two legumes which should be included with one of the grasses to form a grass/legume pasture.

Rhodes grass/lucerne/phasey bean, and green panic/lucerne/phasey bean (Plates 1 and 2), are mixtures which are highly productive and tolerant of hot, dry conditions.

Buffel grass is a native of Africa and Asia which has been introduced and is growing well in parts of Western Australia, Central Australia, North Queensland and in the Central Burnett. Like most tropical species it is frost susceptible but it has the ability to make rapid growth in the spring months. It is well worth planting on the droughty, less fertile, soils of south-eastern Queensland.

Molasses grass is a tropical species which makes exceptionally heavy growth on sandy soils near Brisbane. It must be protected from fire, as burning will destroy the stand.

Plate 2.

Green Panic, Lucerne and Phasey Bean Blend to Form an Excellent Pasture Mixture. This stand is at Moggill, near Brisbane.

All are summer-growing species which will commence growth as early as August and continue until the onset of cold weather. These introduced grasses have the ability to produce a greater bulk of more nutritious pasture than native species.

More than one grass species should not be included in a seed mixture for pastures of this type. When grass mixtures are used there is a tendency for stock to graze preferentially the more palatable grass so that one species will eventually dominate the pasture.

As timeliness is important, seed should be ordered early so that sowing can take place when seedbed conditions are ideal.

The following sowing rates per acre are recommended :

(1) Rhodes grass, 6–8 lb., lucerne, 1½ lb., phasey bean, 1 lb.

(2) Green panic, 6–8 lb., lucerne, 1½ lb., phasey bean, 1 lb.

(3) Buffel grass, 5–6 lb., lucerne, 1½ lb., phasey bean, 1 lb.

(4) Molasses grass, 4–5 lb., phasey bean, 1 lb.

Seed of Rhodes grass, green panic and buffel grass may be obtained from seed merchants or from growers in the Central Burnett, where much of the seed is harvested.

Molasses grass seed, which is produced principally in northern Queensland, is also available from several merchants.

Lucerne seed is readily obtainable. Seed of phasey bean is limited in supply but commercial production of this legume seed is being investigated.

Fertilizer Requirements.

The sandy soils are inherently poor and are usually deficient in plant nutrients, particularly nitrogen and phosphorus. Potassium is also deficient in some areas. Worthwhile results can only be expected if the improved pasture mixture is sown onto a seedbed well supplied with plant foods, and the application of 1 cwt. per acre of a mixed fertilizer is therefore a sound investment. The cost of this application is a small percentage of the total cost of establishment and it can mean the difference between success and failure.

Seedbed Preparation.

Trials have shown that success in establishing a sown pasture depends largely on careful seedbed preparation. To sow grass onto native pastures is a waste of seed. Two objects of seedbed preparation are to kill out undesirable plants which may compete with young seedlings and to conserve moisture. Where blue couch is to be replaced with sown species the first ploughing should take place in late autumn so that frosts will check the regeneration of the couch grass.

The first ploughing should be given six months before it is intended to sow, and subsequent cultivations should be aimed at controlling weeds and producing a shallow, moist, firm seedbed.

Soils on the sandstone slopes are easily eroded, and even when well grassed some storm water runoff is inevitable. Pasture furrows or broad-based contour banks should be constructed prior to the advent of storm rains in the spring. Contour pasture furrows ploughed on the contour at 1 ft. or 2 ft. vertical intervals ensure that runoff is reduced to a minimum, and that this moisture is conserved on the slope where it is required. Contour furrows are considerably less expensive to build than terraces but may need reopening every 12–18 months on these sandy soils.

Sowing.

Pasture mixtures of the species recommended may be sown at either of two distinct times.

The first is in early spring, preferably in September. This is a time of erratic storm rains and young seedlings may be subjected to dry hot weather in midsummer which will cause some loss of stand. However, if the seedbed has been carefully prepared and planting rains fall in September or early October, the pasture can be established successfully and in reasonably good seasons should be ready for grazing in February.

The second sowing period is in February and March. This is the safest time of planting. February and March are usually the months of heaviest rainfall and normally the worst risk of dry, hot weather has passed.

Seed of lucerne and phasey bean should be inoculated prior to sowing. This is important. Inoculum can be obtained on request, free of charge, from the Department of Agriculture and Stock, William Street, Brisbane. Instructions for use of the inoculum are forwarded with the culture. Inoculated legume seed should not be mixed with superphosphate for sowing.

Planting is probably most efficiently carried out using a grain dril or combine. Considerable work has been done on this method of sowing by Departmental officers on the Darling Downs. With some grass seed difficulty may be experienced in sowing by this method.

Rhodes grass does not run freely and some carrier may be necessary. Rice hulls or sieved sawdust may be used. The coarse (oats) side of the grain box should be used and the seed sown through every run of the drill. It is suggested that a setting equivalent to 80 lb. of oats be made for Rhodes grass/lucerne seed mixture with sawdust as a carrier. This setting may have to be increased to about 120 lb. if packing is severe.

Green panic runs more freely, and can be sown without a carrier through every run of the drill, using the fine side (wheat) with a setting of 21 lb. This will give a seeding rate of approximately 6 lb. of green panic seed per acre.

Buffel grass can be machine-sown successfully when mixed with fertilizer and sown through the star-feed type of fertilizer box of the combine.

Planting can also be carried out effectively using a direct drop fertilizer spreader. Seed should be thoroughly mixed with fertilizer before being placed in the spreader. A feed or concrete mixer does an admirable job. There may be a tendency for lighter seed to shake to the top in the box while sowing. To avoid this, the fertilizer and seed should be stirred by hand occasionally during planting. The seed should be covered with light harrows. In general, mixing of the seed and fertilizer is not recommended where legume seed is included, as the inoculum on the seed will be destroyed.

On the sandy soil types, periodic fertilizer applications will be necessary for maximum results from the pasture. Where cropping is not practised a type of direct drop fertilizer distributor can fulfil a dual role. Under these circumstances the fertilizer spreader would be more useful than a grain drill or combine.

In the absence of suitable machines, grass and legume seed must be broadcast by hand and harrowed in.

Pasture Management.

The establishment of a sown pasture involves capital outlay, and if the investment is to pay dividends efficient management is essential. Some simple rules for managing sown pastures are given as follows :—

Pasture plants should be firmly established before grazing commences. If the strike has been poor the pasture should be allowed to seed so that self-sown plants may thicken the stand. Since lucerne in a mixture is always preferentially grazed, rotational or periodic grazing must be practised if the grass-legume balance is to be maintained.

Periodic grazing involves the provision of adequate subdivisional fencing, water and shade. Without these aids to good management, little progress can be expected from a pasture improvement programme. Paddocks should be designed so that they can be effectively grazed in two weeks or less, and closed up for from six to eight weeks. Rotational grazing will enable lucerne in the mixture to make growth, add to its root reserves and maintain sufficient vigour to persist in the pasture.

Shade and water may be provided in a laneway or on an area of native pasture which is easily accessible to sown pasture paddocks. Sown pastures may deteriorate rapidly under sustained heavy grazing. After a pasture has been closely cropped it should be closed, and future grazing deferred for part of the growing season in order that sufficient top growth can be made to replenish plant root reserves.

Efficiently managed pastures build soil fertility. This is brought about by improvement in soil structure by increased amounts of humus or organic matter which accumulate in the soil. The process is a gradual one which continues over a period of years and which is aided by applications of phosphatic fertilizers, the maintenance of legumes in the pasture which increase soil nitrogen, and the return of nutrients to the soil in the form of manure and urine. Improved fertility will be reflected in better growth of pasture.

AGRICULTURE IN THE NORTH.

The expansion of Departmental activities in North Queensland, together with the distance of this region from Brisbane, has made it desirable to have "on the spot" control of Departmental work on tropical agriculture.

To this end, the position of Director of Tropical Agriculture has been created, and Mr. D. O. Atherton, who has been Director of Agriculture for some years past, has been appointed to the position.

The Director of Tropical Agriculture will have control of all crop and pasture work in the far north, including the supervision of experiment stations at South Johnstone, Mareeba and Wrotham Park. The scope of the work is expected to be greatly increased with the development of northern irrigation projects.

Mr. Atherton is a northerner by birth and rearing, and after joining the Department in 1930 spent several years in the north on entomological, pasture and crop work. During the last year of the war he was engaged as an Army Officer on the development of agriculture in New Guinea.

Headquarters of the Director of Tropical Agriculture will be at the Bureau of Tropical Agriculture at South Johnstone.

Mr. W. J. S. Sloan succeeds Mr. Atherton as Director of Agriculture, and Dr. L. G. Miles becomes Assistant Director of Agriculture.

Harvesting, Handling and Packing Pineapples.

C. G. WILLIAMS, Supervisor, Preparation and Transport, Horticulture Branch.

The development of a satisfactory trade in fresh pineapples depends on the fruit being in a sound and palatable condition. The stage of maturity at which the fruit can be picked, and the methods of harvesting, handling and packing, are largely determined by the ultimate destination of the fruit.

The requirements for local and interstate markets have been well established, but careful handling methods and the control of wastage, particularly that due to water blister, still require greater attention from growers. For export to New Zealand, longer transit and additional handlings are involved; the fruit must therefore be cut from the plant and packed in establishments registered as suitable for export under the Commonwealth Export (Fresh Fruit) Regulations.

SELECTION OF FRUIT.

In selecting fruit for the fresh fruit market, particular attention should be given to the rejection of fruit not of normal type. The following types of fruit should be excluded from all packs :—

(*a*) Fruit visibly affected with sunburn, frost injury, yeasty rot, black speck or bruises.

(*b*) Fruit showing any leakage of juice at packing, whether from bruises, growth cracks or other causes.

(*c*) Fruit with more than two tops.

(*d*) Fruit with knobs or slips on the base of the fruit.

(*e*) Fruit without tops or with aborted, dwarfed or deformed tops.

(*f*) Malformed or crippled fruit.

(*g*) Fruit whose stalks have been wholly or partly broken before maturity. Such fruit is invariably of poor quality and subject to black heart.

Very careful selection of fruit is essential for interstate and overseas export and only fruit of the highest quality should be included.

HARVESTING.

Removal of the Fruit from the Plant.

During the summer months, when water blister is likely to be prevalent, fruit for all markets should be cut from the plant with a long, stout-bladed, sharp knife, leaving a basal stem approximately half an inch long. Fruit destined for New Zealand should be cut throughout the year. At the time of packing, the stem should be trimmed back so that it projects not less than a quarter of an inch below the lowest portion of the base of the fruit.

Stage of Maturity.

The stage of maturity at which fruit should be picked depends to a large extent on its ultimate destination. Fruit grown in close proximity to the markets can be picked in a more forward condition than that destined for Sydney and Melbourne markets. Fruit consigned to Adelaide, Hobart or New Zealand must not be more mature than the minimum standard prescribed under the Queensland Fruit and Vegetable Grading and Packing Regulations of 1953.

Handling after Picking.

While careful handling methods from the plantation after picking are essential irrespective of the ultimate destination of the fruit, special care should be taken with fruit exported to distant markets, as the cases are handled a considerable number of times before they reach the consumer. After the fruit is removed from the plant, it may either be carefully placed on top of the plants in the row for subsequent collection in a suitable sized basket, or collected and carried in the arms of the operator or placed directly into the basket; the basket should be padded with woodwool and free from any internal projection.

When the pineapples are being transferred from the harvesting basket, or from the arms of the operator, they should as far as practicable be placed in a harvesting box which will contain fruit of the same size. A rough grading for size in the field saves excessive handling of the fruit prior to final grading at the time of packing. Moreover, if this field grading is done effectively the fruit need only be handled three or four times during the whole operation.

Harvesting containers such as the tropical case or the pineapple factory case, preferably the latter, should be placed at the end of the plantation rows and lined with woodwool or other suitable padding material.

Transport from the Plantation to the Packing Shed.

The most suitable harvesting conveyance is a rubber-tyred vehicle with trailer attached; but whatever type of container or transport vehicle is used, the fruit should not be placed in a high stack, as this is conducive to bruising. If the pineapples are packed above the top of the harvesting box, then the boxes should be stacked in a single layer on the vehicle. If they are packed below the top of the case, the cases can be stacked in two or three layers and woodwool placed between each tier. A horse-drawn slide is not suitable for the transport of pineapples; but, where this type of conveyance is necessary on steep hills, the harvesting cases must not be stacked more than one high.

The Packing Shed.

At the packing shed the harvesting cases should be unloaded onto the floor of the shed and placed in stacks or in single case units containing each grade size. To facilitate packing, the cases should be placed as near as possible to the packing stand.

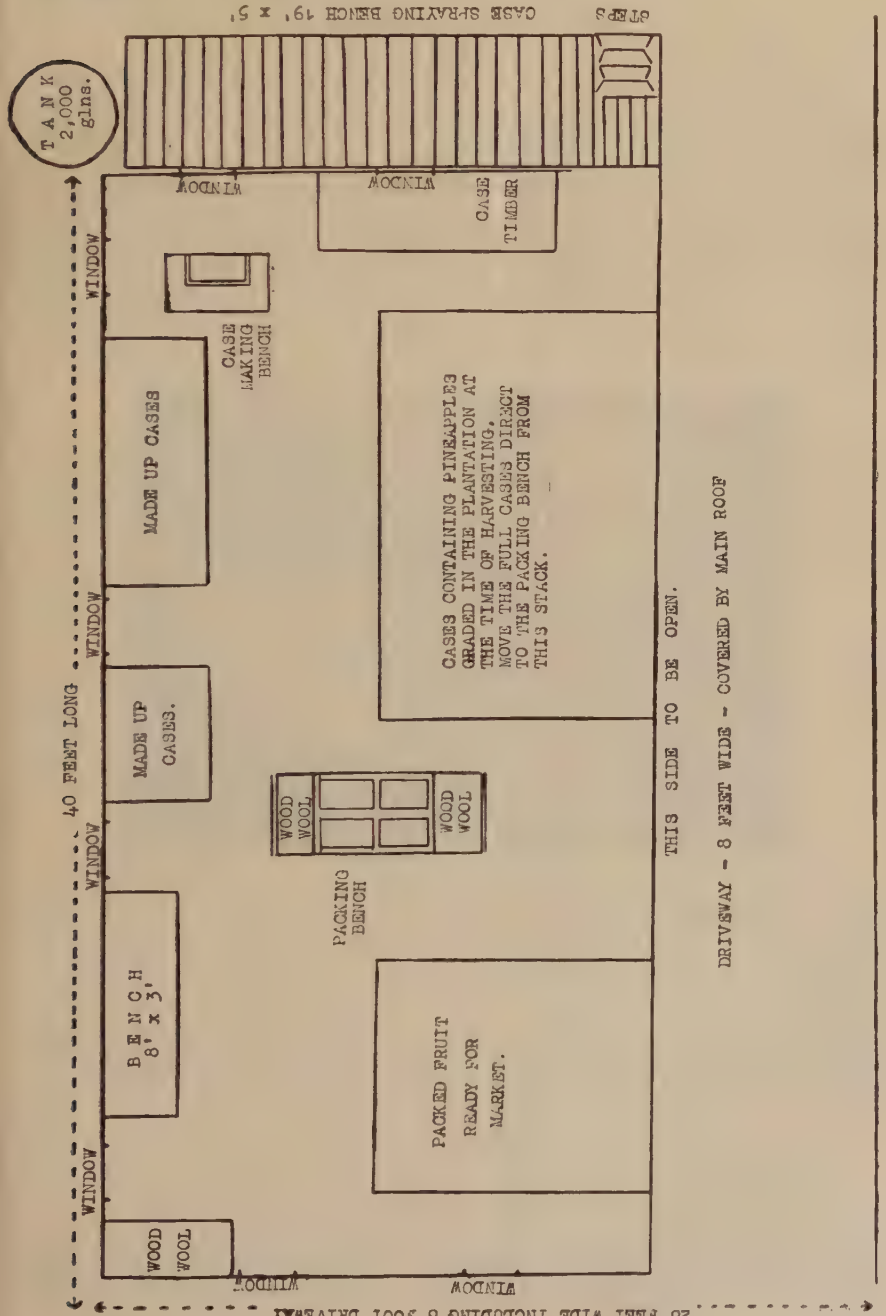

Plate 1.
Ground Floor Plan of Pineapple Packing Shed.

To reduce the number of handlings during packing, a packing stand which will accommodate two or four cases of fruit should be a moveable part of the packing shed equipment. A floor plan of a model packing shed showing the position of a four case packing stand is illustrated in Plate 1.

PACKING SHED OPERATIONS.

Cases.

All fruit should be packed in clean cases. New cases must be used for overseas export, and such cases are desirable for interstate trade. The tropical fruit case (Plate 2) of internal measurements 24¾ in. long x 12 in. deep x 12 in. wide is generally used for all markets, but a smaller box, "the special pineapple case", of internal measurements 24¾ in. long x 10 in. deep x 12 in. wide, is particularly suitable for export. The tropical case is suitable when grading is accurate. However, in pineapple plantations grading is by hand, and accurate grading is difficult. The smaller case has given the more satisfactory results in export, but necessitates the use of a greater amount of woodwool and timber per unit weight of fruit.

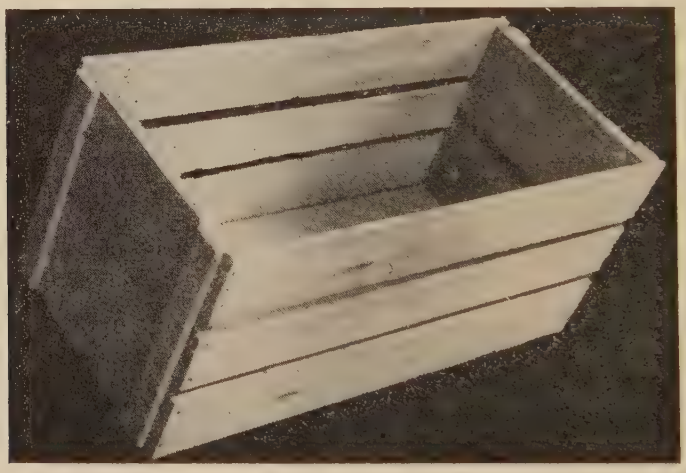

Plate 2.

The Tropical Case. Showing method of making up, with the sides overlapping the top and bottom of the case to an extent equal to the thickness of the top and bottom boards. The cleats are placed parallel to the sides of the case.

Cases described as "Tropical" and "the Special Pineapple case" should be constructed from softwood or hardwood in accordance with the following specifications :—

Tropical Case.

1. Each end shall be 12 inches wide by 12 inches deep by ¾ inch thick and consist of two pieces.

2. Each side shall be of three boards each 26¼ inches long by 5/16 inch thick and aggregate 11 inches in width. An aperture ¾ inch wide shall be allowed between the boards.

3. The top and bottom shall each be of two boards each 26¼ inches long by 5/16 inch thick and aggregate not less than 11½ inches and not more than 12 inches in width.

4. Two cleats each measuring 12 inches long by 2 inches wide by 5/16 inch thick shall be used to join the two pieces of the end boards and shall be placed parallel to the sides of the case.

Special Pineapple Case.

1. Each end shall be 12 inches wide by 10 inches deep by ¾ in. thick and consist of two pieces.

2. Each side shall be of two boards each 26¼ inches long by 5/16 inch thick and aggregate 10 inches in width. An aperture ⅝ inch wide shall be allowed between the boards.

3. The top and bottom shall each be of two boards each 26¼ inches long by 5/16 inch thick and aggregate not less than 11½ inches and not more than 12 inches in width.

4. Two cleats each measuring 10 inches long by 2 inches wide by 5/16 inch thick shall be used to join the two pieces of the end boards and shall be placed parallel to the sides of the case.

Packing Procedure.

Prior to the commencement of packing, one or two boxes of the field graded pineapples should be moved from the intake stack onto the packing stand. The packer will find that, if two or three market cases are conveniently arranged on the opposite side of the stand from the harvesting boxes, he can pack two or three colour or grade sizes simultaneously. This procedure will expedite packing and eliminate extra handling of the fruit when grading for size in the field is not accurate.

Fruit in the packed case should be uniform in size; for export packs it should also be uniform in colour. Oversized tops may be trimmed back to not less than 2 inches from the solid core of the top. Further trimming may result in water blister development.

Grading Rings.

Quite suitable grading rings may be made from heavy gauge wire or by cutting holes of a required diameter out of 3-ply or pine board. A pineapple that will pass through a 4-inch ring but which will not pass through a 3¾-inch ring is classified as 3¾ grade size. For trade purposes the size grade is referred to by the number of pineapples in the case, such as 11, 12, 14, &c., count. Each variety may vary in shape, but provided proper grading methods are used no difficulty should be experienced in packing fruit of regular shape. It is advisable to set aside irregularly shaped pineapples until sufficient fruit of the same size is obtained to pack a full case. Large pineapples are not welcomed by the trade, and fruit larger than 11 count should be forwarded to the factory. Pineapples smaller than 27 count are suitable for local market only.

Method of Packing.

All packs should have the fruit placed across the case with the butts against the side of the case. There are two types of packs—namely, the straight pack for counts of 11–14 and the " head and tails " pack for counts of 15–36. The former pack is sometimes used for a count of 15.

For counts of 11 (Plates 3-5) and 12, the straight pack consists of three layers of fruit of a single row with the butt ends in each layer touching the same side of the case. The pineapples in the second layer are reversed so that the tops touch the same side of the case as the butts in the first and third layer. This method of packing will also apply to counts 14 (Plates 6-8) and 15 when the long, square-shouldered type of fruit is being packed. For these counts a tighter pack is sometimes obtained by reversing the end or centre pineapple in each layer.

Normally shaped pineapples of counts 15, 18, 21 (Plates 9-11), 24 and 27 are packed in three layers each of two rows and placed so that each alternate fruit has its butt end touching the opposite side of the case. Pineapples of counts 28, 32 and 36 are packed in a similar way except that four layers are used.

When placing the pineapple in the case, the packer should make the movement as he places the packing material around the bottom, sides and base of the fruit. Each fruit in the upper layers should be placed between the spaces of the fruits in the lower layer and not directly on top of the fruit.

Packing Material.

Woodwool and blady grass are used as packing materials, but the latter can only be used for fruit sold within the State. Packing material should be used on the top and bottom of the case, between each fruit, and at the base of the fruit where it touches the case. For export packs, approximately $2\frac{1}{2}$ to 3 lb. of woodwool should be used per case. For other packs, $1\frac{1}{2}$ lb. of woodwool per case is sufficient.

Height of Fruit in the Case.

When finished, the top layer of fruit should not be above the case, as sufficient space should be available for a protective layer of packing material. The slight pressure exerted when the case is lidded should result in a firm pack.

PACKING CHART.

The methods of packing the various counts listed in Table 1 are recommended for fruit consigned to local and near interstate markets.

TABLE 1.

Count (Number of Fruit to Case).	Approximate Diameter of Fruit.	Number of Layers in Case.	Number of Fruit in each Layer.
	In.		
11	$5\frac{1}{4}$—$5\frac{1}{2}$	3	4 x 3 x 4
12	$5\frac{1}{8}$—$5\frac{1}{4}$	3	4 x 4 x 4
14	5 —$5\frac{1}{8}$	3	5 x 4 x 5
15	$4\frac{3}{4}$—5	3	5 x 5 x 5
18	$4\frac{1}{2}$—$4\frac{3}{4}$	3	6 x 6 x 6
21	$4\frac{1}{4}$—$4\frac{1}{2}$	3	7 x 7 x 7
24	4 —$4\frac{1}{4}$	3	8 x 8 x 8
27	4	3	9 x 9 x 9
28	4	4	7 x 7 x 7 x 7
32	$3\frac{3}{4}$	4	8 x 8 x 8 x 8
36	$3\frac{1}{2}$	4	9 x 9 x 9 x 9

Plate 3.
11 Count Pack. Bottom layer.

Plate 4.
11 Count Pack. First and second layers, 4 x 3.

Plate 5.
11 Count Pack. Top view of finished case. Three layers, 4 x 3 x 4.

Plate 6.
14 Count Pack. Bottom layer.

Plate 7.
14 Count Pack. Showing position of layers. Three layers, 5 x 4 x 5.

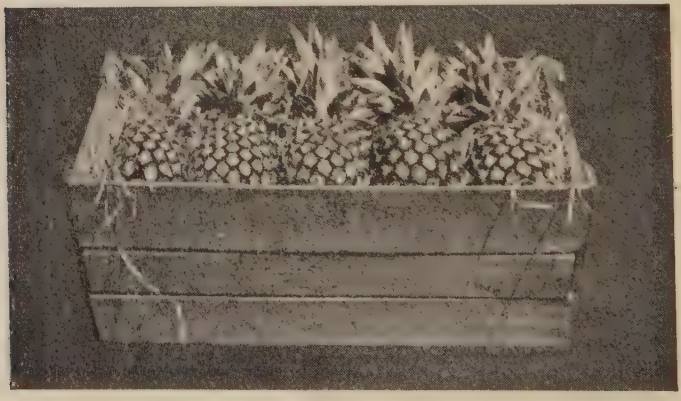

Plate 8.
14 Count Pack. Top view of finished case.

Plate 9.
21 Count Pack. Bottom layer.

Plate 10.
21 Count Pack. Showing position of layers. Three layers, 7 x 7 x 7.

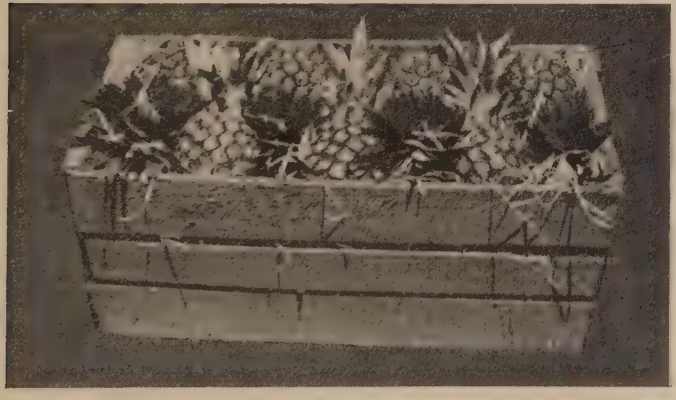

Plate 11.
21 Count Pack. Top view of finished case.

In the export packs, and for fruit likely to receive a considerable number of handlings, more packing material is required to protect each individual fruit against bruising and the fruit should be cut from the plant leaving a basal stem of not less than a quarter of an inch long. The method of packing illustrated in Plate 12 is recommended for pineapples consigned to distant markets.

Plate 12.

Packing Fruit for the Export Packs. The fruit is cut from the plant and adequately protected with woodwool.

REQUIREMENTS FOR VARIOUS MARKETS.

Local and Interstate Pack.

For sale within Australia, the fruit must comply with the grading regulations of the State in which the consignments are eventually sold. Under the Queensland Fruit and Vegetable Packing and Grading Regulations of 1953, pineapples shall be one size, one variety, sound, clean, mature but not over-ripe, of normal shape and appearance and free from broken skins, sunburn or frost injury.

Pineapples of the smooth leaf type shall be not less than $3\frac{3}{4}$ inches and pineapples of the rough leaf type not less than $3\frac{1}{4}$ inches in diameter.

For the purpose of this Regulation relating to pineapples, "mature" means ripe and palatable. In addition—

(*a*) During the months of October to March (both inclusive) the skin of the pineapple shall show at the time of picking a tinge of some yellow colour at the base of the fruit and the juice extracted from the whole fruit shall contain a total solids content of not less than 12%.

(*b*) During the months of April to September (both inclusive) the skin of the pineapple shall contain at the time of picking not less than a quarter yellow colour at the base of the fruit and the juice extracted from the whole fruit shall contain a total solids content of not less than 10%.

Marking of Packages Containing Pineapples for Sale.

(1) Any person who packs for or on sale by wholesale fruit or vegetables in any package shall legibly and durably mark on the outside of such package—

(*a*) The initials (or the Christian name), full surname and address, or in the case of a corporation or unincorporated association the name and address of the packer, or in every case the packer's registered brand, or if the packer is a firm registered as such under "*The Registration of Firms Act of* 1942" the name or registered brand of such firm; and

(*b*) (i.) the word "pineapples" and

(ii) the count of the pineapples contained therein.

(2) He shall completely obliterate or remove from such package any other name, brand, or mark of any kind whatsoever appearing thereon.

(3) Marking as hereinbefore specified shall be in letters of not less than three-quarters of an inch in height.

Export Pack.

Fruit consigned to countries outside Australia must comply with the Commonwealth Export (Fresh Fruit) Regulations. Under these regulations, the export of pineapples is prohibited unless the fruit has been prepared in a registered export establishment, situated in a locality in which pineapples are grown commercially. Any person who is the owner or occupier of any premises used for the receipt, processing, packing or storage of pineapples may apply to the Department of Agriculture and Stock, on the prescribed form, for the registration of his premises as an export establishment.

If the Secretary of the Department of Commerce and Agriculture is satisfied that the premises are constructed, equipped and operated in an efficient and hygienic manner and, in particular, that—

(*a*) they are so constructed as to be adequately lighted for the purposes of efficient inspection of the fruit and the operations of the packing shed;

(*b*) they are ventilated in a manner approved by an officer;

(*c*) their floors are constructed of concrete or other suitable material that permits of rapid and effective cleansing;

(*d*) they and their immediate surroundings are such as to minimize harbourage for fungi or insects and contamination of the fruit by foreign substances during stacking, handling, loading, processing, grading and packing;

(*e*) the plant and equipment are of types approved by an officer,

the Secretary of the Department of Commerce and Agriculture shall register the premises as an export establishment.

The trade description shall be placed on one end of each case and shall set out :—

(*a*) In letters or figures at least $\frac{1}{4}$ inch in height if printed on the cases or applied by means of printed paper labels, and at least $\frac{3}{4}$ inch if stencilled on the cases, the word "pineapples" and the number of pineapples contained in each case.

(*b*) In letters at least ½ inch in height, the word "Australia," the State or Territory in which the fruit was produced, the grower's name or registered brand and the number of his registered establishment.

Growers who are prepared to pack for export can expect a return for their fruit greater than that received for their normal interstate pack.

FACTORY FRUIT.

Harvesting.

In order to obtain fruit which will be acceptable for factory purposes, care must be exercised in handling and preparing the fruit. Prior to the fruit reaching the packing shed, treatment should be the same as that given to fruit intended for the fresh fruit market, except that fruit for factory may be snapped throughout the year. Fruit which is over-ripe is not satisfactory for processing, as it has a fermented flavour and the amount of trimming required is excessive; on the other hand, immature fruit cannot be used as it gives an unsatisfactory canned product.

Grading and Packing.

When the fruit reaches the packing shed, the tops and any knobby basal projections are removed. This should be done by cutting with a sharp knife, as the breaking off of knobs and tops by hand causes considerable damage to the fruit and affords a means of entry for fungi and yeasts. Considerable wastage from water blister frequently occurs through this practice. When the fruit is trimmed it is placed direct into factory cases or crates. The grades required by canneries are described below :—

"*First Grade*": Should be 5 inches or more in diameter; that is, the fruit must not pass through a 5-inch grading ring. The pineapple must be true to type. Abnormally shaped fruit of first grade size must be included in second grade.

"*Second Grade*": Should be 4 inches in diameter and under 5 inches; that is, the pineapple must not pass through a 4-inch grading ring. Fruit must be true to type and have a full length of not less than 5 inches. Abnormally shaped fruit of second grade size must be included in third grade.

"*Third Grade*": Should not be less than $3\frac{3}{4}$ inches in diameter and $4\frac{1}{2}$ inches in length.

"*Fourth Grade*": The fruit must be fully developed and be of not less than 3 inches in diameter and 4 inches in length.

Cannery pineapples are received by the Committee of Direction of Fruit Marketing for distribution to factories subject to the following conditions :—

(1) At loading centres where C.O.D. loaders are employed pineapples will be accepted only through the C.O.D. loader.

(2) All fruit must be freshly picked and loaded in a sound condition.

(3) Only smooth leaf varieties will be accepted.

(4) Fruit must be loaded on regular days as and when instructed.

Grades should be marked distinctly in white chalk on both ends of the cases, as follows :—

First Grade with the numeral 1.
Second Grade with the numeral 2.
Third Grade with the numeral 3.
Fourth Grade with the numeral 4.

C.O.D. Inspectors have been instructed :—

(*a*) If a case of " First Grade " contains one fruit which is undersized, the whole case is to be graded down.

(*b*) If a case of " Second Grade " contains 10 per cent. or more of undersized fruit, the whole case is to be graded down.

(*c*) If a case of " Third Grade " contains 10 per cent. or more of undersized fruit, the whole case is to be graded down.

(*d*) If a case of " Fourth Grade " contains 10 per cent. or more of sub-standard fruit, the whole case is to be rejected.

Plate 13.

Factory Pack Used for Very Large Fruit of Grade 2, Count 14. Bottom layer, 6 lying on the side; middle layer, 2 lying on the side; top layer, 6 lying on the side.

Plate 14.

Factory Pack Used for Large Fruit of Grade 2, Count 16. Bottom layer, 9 standing upright; top layer, 7 (3 pines have been removed to show the bottom layer), 3 lying on the sides lengthwise, and 4 lying on the sides at angle.

Plate 15.

Factory Pack Used for Shorter Fruit of Grade 2, Count 17. Showing arrangement of the fruit in the top layer.

Plate 16.

Factory Pack Used for Shorter Fruit of Grade 2, Count 17. Showing the arrangement of the fruit in the bottom layer.

Colour Standards.

First and Second Grade :	Minimum :	Quarter-colour.
Third Grade :	Minimum :	Half-colour.
Fourth Grade :	Minimum :	Three-quarters colour.

" Quarter " colour means that the fruit should show distinct colour at the base and some colour on the bottom half of the fruit.

" Half " colour means that the fruit should show full colour on the bottom quarter and some colour on the remainder of the fruit.

" Three-quarters " colour means that the fruit should show full colour on the bottom half and some colour on the remainder.

The fruit should show the above minimum colour standards on delivery to factories.

Plate 17.

Factory Pack Used for Large Fruit of Grade 1, Count 20. Top layer, 8 lying on the sides (3 pineapples have been removed to show the bottom layer); bottom layer, 12 pines standing upright.

Plate 18.

Factory Pack Used for Smaller Fruit of Grade 1, Count 27. Both layers standing upright; top layer contains 13 fruit; bottom layer contains 14 fruit.

The external colour may exceed the minimum requirement provided the fruit is not received too ripe at the factory.

Colour standards are varied from time to time and growers are advised through the "Queensland Fruit and Vegetable News" of cannery requirements.

Branding.

All cases must be weighed and the tare to the nearest pound stencilled plainly on the top board of each side of the case. The cases must be branded with the grower's name and station underneath the tare on each side of the case. To facilitate the return of empty cases, all cases must be branded on each end with the code letter or letter allotted to the sending station. When the code is comprised of two letters, these must be shown together.

Cannery pineapples are carried on the railway on a case rate basis and it is therefore necessary that cases be packed to capacity. Care should be exercised to ensure that no fruit projects above the top of the case. The case should contain at least 64 lb. of fruit.

Further information on the basis of acceptance and other cannery requirements can be obtained from the C.O.D.

The methods of packing pineapples for factory purposes are illustrated in Plates 13 to 18.

Control of Wastage.

Wastage is likely to occur, especially in the summer months, through the development of water blister and yeasty rot. The two diseases sometimes occur together, but the former is more common and causes considerable wastage during the humid period of the summer. For the control of these diseases, strict sanitation in the field and packing shed should be practised and very careful handling methods adopted when the disease is likely to occur. All discarded fruit tops and other pineapple debris should be removed from the packing place within 24 hours and either buried or spread out in a heap at least 200 yards from the packing place. The packing shed and equipment should be kept clean, and disinfected once a week by spraying with a $2\frac{1}{2}$ per cent. solution of formalin (4 fl. oz. per gallon). Wounds on the fruit provide entry points for the mould organisms. Such wounds are caused by injuries received during handling, by sunburn, knobs cut or knocked off, cut or broken tops and growth cracks. Fruit for the fresh fruit market or for factory should be handled carefully and cases suspected of being contaminated should be sprayed with a formalin solution.

INOCULATION OF LEGUME SEEDS.

★ ★

The Department of Agriculture and Stock supplies cultures of bacteria for the inoculation of seeds of legumes such as Poona pea, blue lupins, lucerne and clovers.

Seed inoculation is often necessary where the legume intended for planting has not previously been grown successfully, as it provides the plants with bacteria which are necessary for their full development.

Cultures are supplied free and post free. They are in bottles and have to be mixed with skim milk for sprinkling on the seed.

Order from the Under Secretary, Department of Agriculture and Stock, Brisbane, at least 10 days before sowing. State amount and type of seed to be treated.

Abnormal Developments in Germinating French Bean Seed.

N. V. HIBBERD, Inspector, Standards Branch.

In order to fully understand the development of any seed, a knowledge of its structure is necessary, and this need becomes more apparent when abnormalities occur in the growth of the very young seedlings.

Seeds are not to be looked upon merely as inert matter incapable of being injured. On the contrary they consist of living cells waiting for suitable conditions of warmth, moisture and a supply of oxygen to occur so that growth can commence, resulting in the development of a young plant. Because of the life potential of each seed, injury can be caused, resulting in mutilation or destruction of the new plant even before growth commences, and this applies particularly to French bean seed.

Structure of Seed and Seedling.

The structure of a bean seed consists principally of an embryo plant made up of a radicle from which develop the roots, a hypocotyl or embryonic stem, an epicotyl (that portion above the cotyledons consisting of a plumule or shoot), two cotyledons attached to the upper part of the hypocotyl, and a seed coat or testa. The embryo in a bean seed, as in all the larger seeded legumes, is apt to be easily injured because it lies so close to the testa and is anchored at only one point to each cotyledon. The same structure exists in the smaller seeded legumes, but because of their size injury is not nearly as great.

Before considering what constitutes an abnormal bean germination, a definition of a normal seedling is required. This consists of—

(1) An epicotyl in which the plumule is undamaged.

(2) Two cotyledons firmly attached to the hypocotyl—this is most essential, as the cotyledons are made up of a reservoir of food from which the young seedling draws its requirements in the early stages of growth.

(3) An undamaged hypocotyl—injury here could result in the radicle not developing.

(4) An undamaged radicle from which must quickly grow the root system to supply nourishment from the soil to the young plant.

Abnormalities.

An abnormal seedling is one in which any of the above are damaged to an extent where development of that part, and consequently of the seedling, is seriously hindered. Among abnormalities encountered in the examination of bean seed are—

(1) *Baldhead*, where the two primary leaves and terminal bud do not develop due to being completely severed, or fractured to an extent where growth cannot take place. Quite often the damaged plumule only needs a slight touch to dislodge it.

(2) *Detached cotyledons*, one or both of the cotyledons being detached from the hypocotyl. In some cases a cotyledon may only be partly fractured but the injury may heal, leaving the cotyledon to carry on its normal function.

(3) *Weak seedlings*, seedlings which develop only weak growth under optimum conditions in the laboratory and certainly could not be expected to produce normal growth in the field.

(4) "*Splits*", seeds so badly damaged that no development of any consequence can take place.

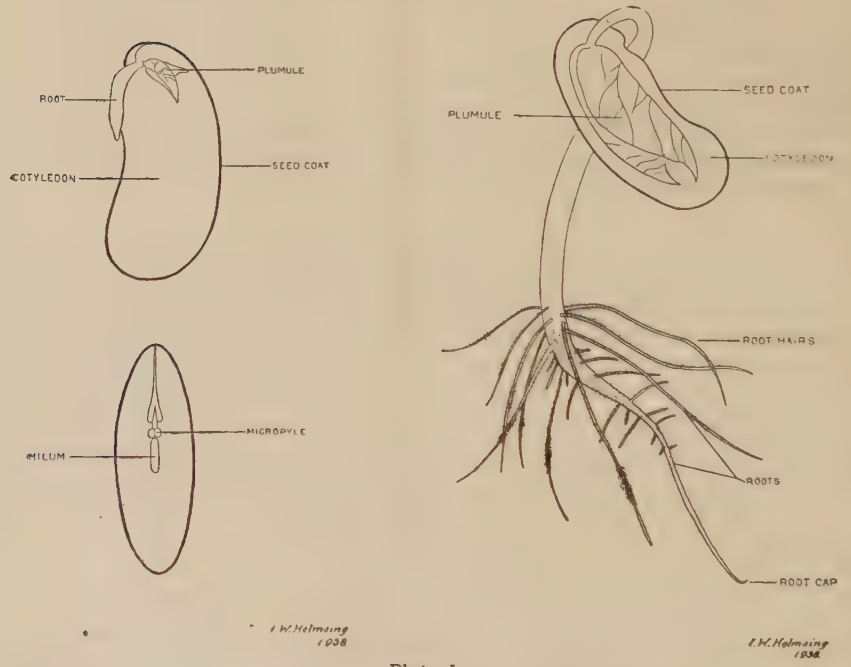

Plate 1.

Structure of the Normal Seed and Seedling of French Bean.

An interesting feature of bean seed is the ability of the seed to produce adventitious roots at the point of injury. Roots have been seen growing from the junction of a cotyledon and hypocotyl where injury has occurred, and from a hypocotyl at the site of an injury. Even cotyledons which have become completely detached from the hypocotyl have shown the same characteristic.

Plate 2.

Normal and Abnormal Seeds and Seedlings. A, normal seedlings. B, baldhead plants. C, weak germinations. D, splits.

Laboratory Examination.

In accordance with the International Rules for Seed Testing, where a germination test is made on a sample of French bean seed, the germination percentage includes only those seedlings which develop normally. Therefore a person submitting a sample for analysis can expect to have included in the percentage germination only those seeds capable of producing strong, vigorous plants under field conditions.

The main difference between the germination of French bean seed and that of wheat and maize is that with wheat and maize the radicle and plumule emerge almost simultaneously, while with bean seed the cotyledons, with the plumule lying between them and completely protected and invisible, are carried above the surface of the soil by the elongation of the hypocotyl. This in effect means that before a bean seedling can be classed as " normal," the plumule must be exposed for examination. Two methods are available—either growing the seed in sand and allowing growth to proceed until the cotyledons open and the plumule emerges ; or in the laboratory the seeds are germinated on towelling or flannelette and after 3 or 4 days are bisected, leaving the plumule visible, when it is a simple matter to determine a " baldhead " abnormality.

Abnormalities other than baldhead are easily detected visibly in the laboratory during a germination test. Recently, samples received for analysis have contained as many as 40% of seeds which develop abnormally and all types of abnormalities have been present.

Causes of Abnormal Germinations.

The chief cause of abnormal bean seed germinations is the result of mechanical injury during—

(1) Threshing of the crop, when the seeds are subjected to too great a force to remove them from the pods. The speed of the thresher and type of threshing drum influence the amount of damage done.

(2) Cleaning of the seed by machinery, particularly where the seeds are elevated and then allowed to fall for some distance.

(3) Subsequent rough handling during storage.

Undoubtedly, the greatest damage is done during the threshing of the crop and it appears that the moisture content of the seed has a direct bearing on the amount of damage—the drier the seed, the more brittle it is and therefore the greater the damage.

An immediate appreciation of the amount of damage caused mechanically is obtained visibly by examining the testa or seed coats. A large percentage of damaged or cracked testa indicates a high percentage of abnormal germinations.

Once the seed has been damaged but still remains intact, it is doubtful whether any type of cleaning or grading machine can effect any appreciable improvement in the germination percentage. A recent trial with a specific gravity separator was unsuccessful. Hand picking of the seed is also not entirely satisfactory, as the injury is often invisible, as in "baldhead."

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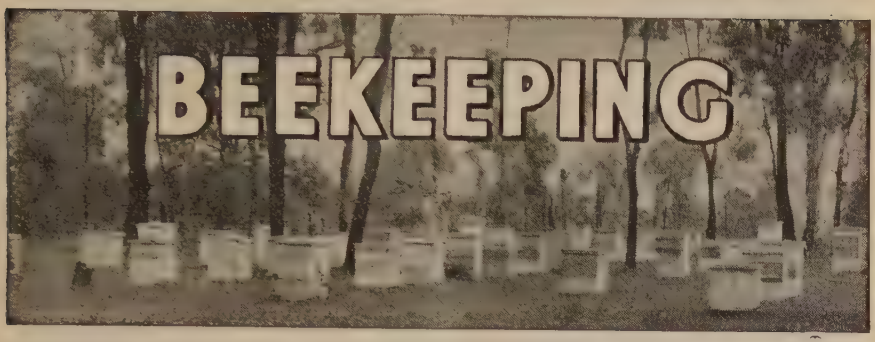


The Honey Flora of South-Eastern Queensland.

S. T. BLAKE (Botanist) and C. ROFF (Adviser in Apiculture).

(*Continued from page 344 of the December issue.*)

Scrub Box.

Botanical Name.—*Tristania conferta* R. Br.

Other Common Names.—Brush box, Brisbane box, pink box.

Distinguishing Features.—Tree with brown or grey scaly bark on the lower or greater part of the trunk, pinkish or greenish smooth bark on the branches and upper part of the trunk, relatively broad glossy green leaves clustered at the ends of the twigs and stamens arranged in five bundles (Plates 65-67).

Description.—This is a tree up to 120 ft. or more high. The bark on the lower or greater part of the trunk is brown or grey and scaly, resembling that of the boxes, while on the upper part of the tree it is smooth and pinkish or greenish and shed in strips each year like the gums. The young shoots exude a milky juice when broken. The leaves tend to be crowded in 3's, 4's or 5's at the end of the twigs ; they are about 2 to nearly 4 times as long as wide, tapered at both ends and pointed at the tip, mostly 3½–6 in. long, glossy green above, paler and duller underneath. The flowers are borne in little clusters near the ends of the twigs and are about 1 in. wide when fully open. There are 5 narrow pointed sepals and 5 more or less rounded petals. There are 5 distinct bundles of stamens, each bundle carrying a large number of small stalked anthers. The fruit or seed-capsule is bell-shaped, ½ in. long or slightly less, opening at the top in 3 valves like that of some eucalypts.

Distribution.—Scrub and forest country chiefly in the Moreton and Wide Bay Districts, especially where these two types of country meet. It is fairly common in the coastal districts of northern New South Wales and central Queensland.

Usual Flowering Time.—December–January.

Colour of Honey.—Light amber.

Importance as Source of Honey.—Medium.

Importance as Source of Pollen.—Minor.

Plate 65.
Scrub Box (Tristania conferta). Branchlet with leaves and flowers.

Plate 66.
Scrub Box (Tristania conferta). Portion of trunk.

General Remarks.—Scrub box is an erratic nectar-producing tree, yielding best on high country. Occasionally, it produces nectar heavily and a large crop of honey is obtained. In such a season the species may become a major honey source.

The honey is first grade, with an excellent, slightly aromatic flavour and reasonable density; it candies quickly with a whitish hard grain. The honey is popular for blending purposes.

The tree is an unreliable source of pollen.

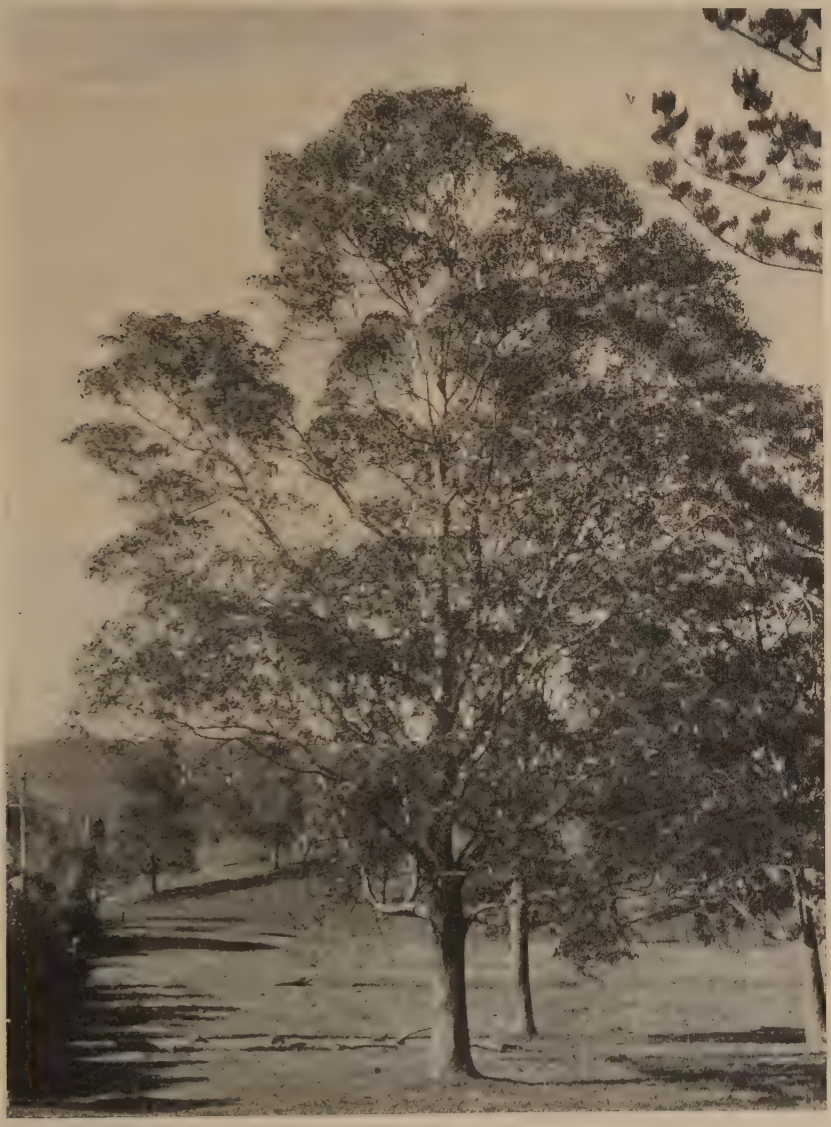


Plate 67.
Scrub Box (Tristania conferta). Kenmore.

(TO BE CONTINUED.)

Management of Sows.

F. BOSTOCK, Officer in Charge, Pig Branch.

From observations both in this country and overseas it is known that—

(1) A considerable proportion of sows fail to get in pig immediately after weaning a litter.
(2) Where conception takes place about one-third of the ova shed do not give rise to full-time offspring.
(3) Nearly 5% of all pigs born are born dead.
(4) A further 15% die before weaning, generally in the first two or three days.
(5) In large litters the average birth weight is usually low, and small, poorly developed pigs are likely to be born dead, to perish early after birth, or to be slow growers if they do survive.
(6) In general the more pigs born in a litter the greater the number weaned.

Sows when fed so that they do not become too poor at weaning time, and are rapidly improving in condition when they take the boar and for a few weeks after mating, are more likely to breed regularly than are sows which are allowed to become poor or are merely turned out in the grazing paddock, without any extra feeding, after weaning a litter.

Low number of pigs reared per sow and failure to get two litters per year can be very largely overcome if more attention is given to husbandry methods.

Feeding during the last six weeks of pregnancy is most important to ensure well developed pigs at birth. The ration should be rich in protein, in order to nourish the rapidly developing litter and provide sufficient to enable the sow to improve in condition without becoming over-fat. These general principles of feeding the pregnant sow, if properly applied, should result in fewer stillborns, stronger pigs born (which are less likely to die in the first few days of life) and rapidly growing young stock.

Losses at and shortly after farrowing to a large extent depend on the selection of breeding stock and temperament of the sow, for the mothering instinct well developed will always be of great importance. Do not keep a clumsy sow.

See that the boar is kept in good working condition, without sudden variations of food or alternating periods of starvation and over-feeding. Keep the boar in a pen by himself and turn sows in for mating on the second or third day of heat.

ANIMAL HEALTH

Lead Poisoning in Cattle.

C. P. CRAVEN, Veterinary Officer, Veterinary Services Branch.

Lead is more often a cause of poisoning in cattle, particularly in young animals, than is commonly realized. It is a complaint that can quite easily be prevented by acquiring knowledge of the disease and carrying out proper management.

Origin of Lead.

Sufficient lead to produce poisoning can be obtained from the following sources :—

(1) *Lead Paints.*—One of the commonest sources is old paint tins that have been discarded where animals can obtain access to them. A freshly painted fence may also be the source, and even with weathering a painted fence may remain poisonous.

Fodder from a silo which is painted inside with a lead paint can also produce lead poisoning.

Plate 1.

Discarded Paint Tins and Car Batteries are Common Sources of Lead Poisoning in Cattle.

(2) *Old Car Batteries.*—These are sometimes thrown onto rubbish heaps which are accessible to cattle. The lead terminals and the lead plates of these batteries are a common source of lead.

Young cattle are very prone to licking and can very easily pick up the small amount of lead that is required to produce poisoning by licking such sources of lead as described in (1) and (2).

(3) *Lead Sprays.*—These are sometimes used for spraying fruit trees to eradicate pests. If grass is contaminated with this spray and cattle eat such grass serious loss can occur.

(4) *Mining Operations.*—Contamination of local pasture by smelter fumes or tailings from certain mines sometimes produces poisoning in stock.

(5) *Lead Pipes or Lead Glazed Earthenware.*—Soft waters can take up lead from such items. A bright shining internal surface of pipes is an indication that lead is being released.

(6) *Lead Medicaments.*—Certain applications used for medicinal purposes on the skin of animals contain lead, and if these are licked the animal may absorb sufficient to be harmful.

The Action of Lead on the Body.

Lead compounds have a caustic action when in contact with certain tissues of the body. This produces a severe irritation, with accompanying symptoms and obvious pain. Lead is very slowly excreted from the body, hence its effects may be fairly long lasting. It also affects the brain and certain nerves of the body, producing signs of nervous derangement, such abnormality leading to suspicion of lead poisoning.

Symptoms.

These occur as three types, depending on the amount of lead that is ingested by the animal.

(1) *The Peracute Type.*—This is the commonest form seen and results from a fairly large absorption of lead. The symptoms are due mainly to the effect on the brain.

Charging, staggering, walking in circles, blindness, walking into objects, and bellowing with a marked change in voice, are all indications of a severe nervous upset produced by lead.

The animal may grind its teeth, champ the jaws, or snap the eyelids, but the general "madness" with death in convulsions following in 4–5 hours after onset of symptoms is the usual picture.

(2) *The Acute Type.*—The caustic effect of lead on the lining of the intestines produces most of the symptoms in these cases. The animal will be "off" its feed, and show obvious evidence of abdominal pain, such as kicking at the belly and groaning. There will be a very severe dark-coloured diarrhoea, and some of the symptoms as described for the peracute type may be superimposed. This type is not as common as the first, and death if it occurs will not be as rapid.

(3) *The Subacute Type.*—This is similar to the acute type but not as severe. In these cases the animal has not absorbed as much lead, and provided the source of poisoning is taken away, recovery frequently takes place.

Post-Mortem Examination.

In the peracute type the effects on the body may not be visible to the naked eye. However, in some cases there is severe engorgement of the blood vessels of the skin, the liver and the spleen. The brain may be soft and spongy and the ridges less pronounced.

The acute type will be indicated by severe inflammation of the lining of the fourth stomach and the intestines. The liver and kidney may have an intense yellowish discolouration and the faeces may be distinctly black.

In the subacute type the post-mortem appearance will be similar to that in the acute type but not so marked.

If within reasonable distance of one of the Animal Health Stations at Brisbane or Oonoonba (Townsville), specimens for chemical analysis may be forwarded. If obtainable send about 2 lb. each of the contents of the abomasum (fourth stomach) and rumen (paunch). About 1 lb. of liver, a kidney, and a urine specimen should also be sent if available. The liver and stomach contents must be in separate airtight screw-top jars.

Diagnosis.

The diagnosis of lead poisoning is based on the following considerations :—

(1) Symptoms of nervous derangement and/or abdominal pain with diarrhoea.

(2) History of contact with lead.

(3) Post-mortem appearances.

(4) Chemical analysis.

Lead poisoning may be confused with other diseases affecting cattle, but certain small points will help to differentiate these from lead poisoning. Such diseases and their special features are listed below.

(1) *Acetonemia.*—In this case the animal may show nervous symptoms, but the condition is distinguished from lead poisoning by the strong smell of acetone on the breath.

(2) *Inflammation of the brain.*—This disease, although similar to lead poisoning, runs a much longer course.

(3) *Noogoora burr poisoning.*—Nervous symptoms and diarrhoea may be displayed in this condition, but usually a history of contact with the two-leaved stage of Noogoora burr will be sufficient to differentiate it.

(4) *Grass tetany.*—The nervous symptoms of grass tetany closely resemble those of lead poisoning. This disease occurs most often in cows at the peak of their lactation and when feeding on lush green feed. Response to treatment is rapid.

(5) *Ergot poisoning.*—This occurs only in areas where paspalum or water couch is growing and if animals are removed from such pastures recovery takes place.

Treatment.

Treatment of lead poisoning is aimed at the following :—

(1) To evacuate lead from the intestines. This is done by the use of an oily aperient such as liquid paraffin.

(2) To neutralise any residual lead. Small amounts of Epsom salts when given as a drench react chemically with the lead to produce a compound which is insoluble.

(3) To hasten deposition of lead in the bones. A diet high in calcium, such as milk, will help to do this. In severe cases it may be necessary to give an injection of calcium borogluconate for the purpose.

Treatment of lead poisoning is, however, not particularly satisfactory. Prevention, by eliminating all sources of lead to which animals may gain access, is by far the better policy to pursue.

HAVE YOUR SEEDS TESTED FREE

The Department of Agriculture and Stock examines FREE OF CHARGE samples representing seed purchased by farmers for their own sowing.

The sample submitted should be representative of the bulk and a covering letter should be sent advising despatch of the sample.

MARK YOUR SAMPLE

Sample of ..... seed
Drawn from ..... bags
Representing a total of .....
Purchased from .....
Name and Address of Sender
Date.....

SIZE OF SAMPLE

Barley	8 oz.	Oats	8 oz.
Beans	8 oz.	Peas	8 oz.
Grasses	2 oz.	Sorghum	4 oz
Lucerne	4 oz.	Sudan	4 oz.
Millets	4 oz.	Wheat	8 oz.

Vegetable Seeds - ½ oz.

SEND YOUR SAMPLE TO—**STANDARDS OFFICER, DEPARTMENT OF AGRICULTURE AND STOCK, BRISBANE.**

Agricultural Chemistry

Clearing Muddy Water.

H. HASSLER, Chemist, Chemical Laboratory.

Water stored in earth tanks often becomes both unpalatable to stock and unsuitable for domestic use on account of muddiness. This is particularly the case after a long spell of dry weather or after a sudden heavy storm, especially if the soil of the catchment area is clayey in nature. In such cases, clayey material which is too fine to settle remains in suspension and gives the water a muddy appearance.

It has been found by laboratory tests that such water may be clarified by the precipitating action of small amounts of harmless chemicals. The precipitate settles fairly rapidly and carries down with it other suspended matter in the water.

The most commonly used chemical for this purpose is alum, which is sold commercially as crude sulphate of alumina at a cost of a few pence per pound. A 3–5% solution (that is, 3–5 lb. of alum per 10 gallons of water) is fed into the tank or dam. It is impossible to determine the correct amount necessary for clarification without conducting a few preliminary tests.

No other chemical than alum is needed in most cases, but occasionally the water is too alkaline for alum precipitation without first being treated with sulphuric acid. Other waters may be too acid and these will have to be pre-treated with soda ash. The requisite amounts of these chemicals must be found by experiment. With alum, the best coagulation of the suspended clay occurs when the water is neither acid nor alkaline but neutral in reaction.

The process of clarification is carried out in the following manner :—

First, the alum solution (3–5%) is made up as previously described. About two-thirds of a pint of this solution is then slowly added, with constant gentle stirring, to four gallons of the water to be cleared. The mixture is allowed to stand undisturbed for some hours.

If the water was approximately neutral before treatment, it will be found that the suspended material has settled, leaving clear water on top.

If the water clears very slowly, it may be necessary to treat another sample with a larger volume of alum solution. If it clears very rapidly, a smaller amount of alum solution than two-thirds of a pint to four gallons should be used in clearing the affected water ; otherwise the water may have a slightly astringent taste.

It is only rarely that soda ash in addition to alum is required. It will be needed in cases where the water in the experiment outlined above does not clear after standing for 12 hours or so. In this event, another sample of water should be taken and pre-treated with a small quantity of soda ash or washing soda at the rate of 2½ oz. per 10 gallons of water.

For the clarification of water in earth tanks or dams, it is advisable to carry out the treatment in a storage tank. This is necessary because—

(*a*) The least disturbance of the clay on the sides or bottom of the reservoir, such as might be caused by stock drinking or by wind waves, will again make the water muddy.

(*b*) The action of the chemical on the clay of the reservoir may be such that the water-holding quality of the clay is impaired; this would permit the water to leak away.

The storage tank in which the clarification is to be carried out should be constructed so that the sludge can be removed easily after the clear water has been withdrawn. A suitable arrangement would be to have two outlet pipes to the tank, one flush with the bottom to remove the sludge and the other extending some distance into the tank to draw off the clear water.

From the preliminary experiments carried out it will be possible to calculate the amount of alum solution that will be necessary to clarify the quantity of water contained in the storage tank. If this alum solution is now added to the water in the tank and the whole stirred gently, then allowed to stand, the suspended material will precipitate and the water above will be perfectly clear.

Vitamins and Livestock.

R. J. W. GARTNER, Chemical Laboratory.

Prior to 1906 it was generally believed that a complete ration for livestock contained only proteins, carbohydrates, fats and mineral matter. In that year Hopkins recorded the need for a further "accessory food factor" if rats were to develop normally. Since then the existence of at least 15 of these essential factors, now called vitamins, has been established.

Not all have to be considered under normal conditions of livestock production in this State, but in special cases such as drought or intensive housing or for exceptionally high producing animals, vitamin supplements may be necessary. These are briefly discussed.

Vitamin A.

One of the main functions of vitamin A is the maintenance of surface tissues in a healthy state to resist bacterial infection. Vitamin A deficiency can inhibit successful reproduction and depress rate of growth.

Livestock depend on their food for vitamin A either in the form of carotinoids (the precursors from which the body produces vitamin A) or as the vitamin itself. All green parts of growing plants are rich in these carotenoids, but cereal grains, with the exception of maize, are deficient.

The young of most animals first get their intake of vitamin A from colostrum and for some time after through the milk fats. As the intake of grass increases, more and more of the vitamin is self-gathered until at weaning the young are self supporting.

Reserves are concentrated in the liver and these are drawn upon in times of nutritional stress. Because of their relatively higher requirements,

young stock are more rapidly depleted than other animals and so in prolonged drought they should be the first to receive bright hay, silage or vitamin A concentrates.

It is also necessary to add the vitamin to rations composed largely of white grains or highly processed by-products.

Vitamin B_1 (Aneurin or Thiamin).

Lack of this factor causes nervous symptoms, failure to grow normally and general weakness. It is synthesised by micro-organisms in the paunch of ruminants. This is also true of other water-soluble vitamins comprising the B complex, so that the ruminant is not likely to suffer from lack of B vitamins if it obtains sufficient food for bodily needs. In view of the widespread distribution of this group of vitamins, gross deficiency symptoms are not common.

Vitamin B_2 (Riboflavin).

Riboflavin (vitamin B_2) is sometimes grouped with B_1. It is widely distributed also and the special condition under which a lack is apparent in Queensland is poultry feeding without sufficient green feed. For good hatchability and satisfactory growth, fortification with riboflavin is advisable.

Milk, milk by-products, yeast and distilling by-products are rich in riboflavin.

Vitamin B_{12} (Animal Protein Factor).

This is found in animal but not in vegetable protein, hence the alternative name. It is responsible for growth promotion and has a special significance in the anaemia of cobalt deficiency of ruminants. Vitamin B_{12} contains cobalt. Addition of this vitamin to rations entirely composed of vegetable foods enhances the liveweight gains of pigs and poultry.

Vitamin C (Ascorbic or Cevitamic acid).

This is necessary for livestock but in general enough is synthesised in the body. The special needs of impotent bulls and disease-susceptible calves are about the only two cases where vitamin C medication is called for.

Vitamins D, D_2, and D_3.

The D vitamins regulate assimilation and utilisation of calcium and phosphorus. They are therefore of importance in the prevention of rickets. The periods of greatest need are during growth, pregnancy and lactation. Sunlight enables surface tissue to produce vitamin D from a precursor, so under most conditions of livestock production in Queensland the anti-rachitic vitamin is not lacking. But there are special conditions in poultry production when vitamin D supplements must be fed if " leg weakness " is to be combated.

Vitamin E (Tocopherol).

This vitamin, which is so intimately associated with reproduction, is widely distributed. It is found chiefly in green food and seeds, so it is only under very special conditions that is is likely to be lacking.

Vitamin K (Antihaemorrhagic Vitamin).

This is important in the mechanism of blood clotting but the special conditions under which its use is indicated do not occur in Queensland.

Brucellosis Testing of Swine.

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

TESTED HERDS (As at 15th December, 1953).

Berkshire.

J. J. Bailey, "Lucydale" Stud, East Greenmount
S. Cochrane, "Stanroy" Stud, Felton
G. Handley, "Handleigh" Stud, Murphy's Creek
J. L. Handley, "Meadow Vale" Stud, Lockyer
R. G. Koplick, "Melan Terez" Stud, Rochedale
O'Brien and Hickey, "Kildurham" Stud, Jandowae East
E. Pukallus, "Plainby" Stud, Crow's Nest
G. C. Traves, "Wynwood" Stud, Oakey
E. Tumbridge, "Bidwell" Stud, Oakey
Westbrook Farm Home for Boys, Westbrook
H.M. State Farm, "Palen" Stud, Palen Creek
A. R. Ludwig and Sons, "Cryna" Stud, Beaudesert
H. H. Sellars, "Tabooba" Stud, Beaudesert
D. T. Law, "Rossvill" Stud, Trouts road, Aspley
R. H. Crawley, "Rockthorpe" Stud, *via* Pittsworth
F. R. J. Cook, "Alstonvilla," Wolvi, *via* Gympie
Mrs. I. M. James, "Kenmore" Stud, Cambooya
H. L. Stark, "Florida," Kalbar
J. H. N. Stoodley, "Stoodville," Ormiston
H.M. State Farm, Numinbah
V. G. M. and A. G. Brown, "Bardell," Goovigen
R. E. Paulsen, "Crest" Stud, Binjour Plateau, M.S. 670, Gayndah
M. G. and R. H. Atkins, "Diamond Valley" Stud, Mooloolah
L. Puschmann, "Tayfeld" Stud, Taylor
Dr. B. J. Butcher and A. J. Parnwell, 684 Logan road, Greenslopes
W. F. Ruhle, "Felbar" Stud, Kalbar
C. E. Edwards, "Spring Valley" Stud, Kingaroy
G. J. McLennan, "Murcott" Stud, Willowvale
H. M. Wyatte, "Deepwater" Stud, Rocky Creek, Yarraman
C. F. W. and B. A. Shellback, "Redvilla" Stud, Kingaroy
R. J. Webber, "Webberberry" Stud, 35 Caxton st., Petrie Terrace
J. C. Lees, "Bridge View" Stud, Yandina
B. J. Jensen, "Bremerside" Stud, Rosevale, *via* Rosewood
F. Thomas, "Rosevale" Stud, M.S. 373, Beaudesert

Large White.

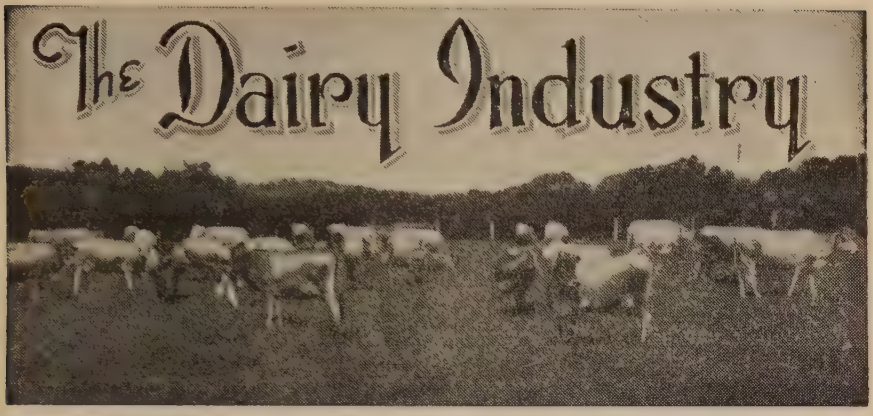
H. J. Franks and Sons, "Delvue" Stud, Cawdor
Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
J. A. Heading, "Highfields," Murgon
K. B. Jones, "Cefn" Stud, Pilton
R. G. Koplick "Melan Terez" Stud, Rochedale
R. Postle, "Yarralla" Stud, Pittsworth
E. J. Bell, "Dorne" Stud, Chinchilla
L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
H. R. Gibson, "Thistleton" Stud, Maleny
H.M. State Farm, Numinbah
K. A. Hancock, "Laurestonvale" Stud, Murgon
V. P. McGoldrick, "Fairymeadow" Stud, Cooroy
R. S. Powell, "Kybong" Stud, Kybong, *via* Gympie
S. T. Fowler, "Kenstan" Stud, Pittsworth
H. L. Larsen, "Oakway," Kingaroy
C. Allison, "Colrene" Stud, Lake and Reserve roads, Slacks Creek
E. G. Evans, "Lauraven" Stud, Box 22, Maleny
Mrs. I. G. Utting, "White Lodge," Mountain road, Cooroy
N. E. Meyers, Halpine Plantation, Kallangur
Dr. B. J. Butcher and A. J. Parnwell, 684 Logan road, Greenslopes
G. I. Skyring, "Bellwood" Stud, *via* Pomona
O. J. Horton, "Manneum Brae" Stud, Manneum, Kingaroy
M. E. Bryant, "Maryland Brae" Stud, Blunder road, Oxley
Miss G. R. Charity, Coondoo, Kin Kin.
W. J. Blakeney, "Talgai" Stud, Clifton
F. K. Wright, Narangba, N. C. Line

Tamworth.

S. Kanowski, "Miecho" Stud, Pinelands
N. R. Potter, "Actonvale" Stud, Wellcamp
D. F. L. Skerman, "Waverley" Stud, Kaimkillenbun
A. C. Fletcher, "Myola" Stud, Jimbour
Salvation Army Home for Boys, "Canaan" Stud, Riverview
A. J. Surman, "Namrus" Stud, Noble road, Goodna
Department of Agriculture and Stock, Regional Experiment Station, Kairi
E. C. Phillips, "Sunny View," M.S. 90, Kingaroy
F. N. Hales, Kerry Road, Beaudesert
T. A. Stephen, "Withcott," Helidon
W. F. Kajewski, "Glenroy" Stud, Glencoe
A. A. Herbst, "Hillbanside" Stud, Bahr Scrub *via* Beenleigh
R. G. Koplick, "Melan Terez" Stud, Rochedale
H.M. State Farm, Numinbah
D. B. Alexander, "Debreczen" Stud, Kinleymore *via* Murgon
Dr. B. J. Butcher and A. J. Parnwell, 684 Logan road, Greenslopes
M. E. Bryant, "Maryland Brae" Stud, Blunder road, Oxley
G. H. Sattler, Landsborough
F. Thomas, "Rosevale" Stud, M.S. 373, Beaudesert

Wessex Saddleback.

W. S. Douglas, "Greylight" Stud, Goombungee
D. Kay and P. Hunting, "Kazan" Stud, Goodna
J. Gleeson, "Iona Vale" Stud, Kuraby
C. R. Smith, "Belton Park" Stud, Nara
H. H. Sellars, "Tabooba" Stud, Beaudesert
H. Thomas, "Eurara" Stud, Beaudesert
D. T. Law, "Rossvill" Stud, Trout road, Aspley
J. B. Dunlop, "Kurrawyn" Stud, Acacia road, Kuraby
A. Curd, "Kilrock" Stud, Box 35, Jandowae
F. K. Wright, Narangba, N. C. Line
C. Allison, "Colrene" Stud, Lake and Reserve roads, Slacks Creek
R. A. Collings, "Rutholme" Stud, Waterford
M. Nielsen, "Cressbrook" Stud, Goomburra
G. J. Cooper, "Cedar Glen" Stud, Yarraman
M. E. Bryant, "Maryland Brae" Stud, Blunder road, Oxley
A. H. Groves, "Kinvara" Stud, Ingleside, West Burleigh
J. E. Heath, "Springlea" Stud, Murgon



The Manufacture of Cheddar Cheese in Queensland.

E. B. RICE and T. A. MORRIS, Division of Dairying.

(*Continued from page 370 of the December issue.*)

THE PROCESS OF CHEDDAR CHEESEMAKING.

The factors essential for success in producing cheese of good quality are :—

(1) Milk of reasonable richness in both fat and other solids, produced, handled and kept under clean conditions.

(2) Factory and equipment of a reasonable standard, preferably equipped with pasteurising facilities, and maintained in a sanitary condition.

(3) A good, active, uncontaminated starter.

(4) Skilled factory operatives.

The following are the methods normally followed in making cheddar cheese in Queensland. Minor modifications are necessary in individual factories, for it is not practicable to apply strictly uniform practices in all factories of the State because of differences in breeds of cows, soil, climate and other conditions existing in the different districts. These variations are reflected in changes in the composition of the milk which may necessitate different methods of treatment. The methods applicable when dealing with abnormal milk or other circumstances which necessitate a departure from normal manufacturing procedures will be dealt with later in connection with defects in cheese.

Receiving the Milk.

Upon arrival at the factory the milk is tipped into the weighing vat (Plate 10), sampled for fat and, if necessary, quality tests, weighed and the weight recorded in the platform book. It is then gravitated from the weighing vat to a receiving vat in the factory, where it is held until it is pasteurised. It is directed, following pasteurisation and cooling to a temperature of 86–88° F., through a chute or by pipe-line to the cheesemaking vat. Cheesemaking vats vary from 600 to 1,000 gallons capacity, and are steam-jacketed. They are lined with either tinned steel or stainless steel and have a wooden or metal outer casing.

Plate 10.

Milk Receiving Equipment. This is a common arrangement for receiving milk at Queensland cheese factories. However, the present tendency is to set the scale-vat lower down into the stage so that the cans of milk can be tipped directly, by one man, without any lifting. (A milk-sample cabinet is visible on the left).

Addition of Starter.

Cheese is usually made from night's and morning's mixed milk. Given cleanly produced milk which has not been subjected to high temperature overnight, the mixed milk is as suitable as morning's milk only.

The amount of starter required to produce the desired wheying-off acidity in the normal time of $2\frac{1}{4}$–$2\frac{1}{2}$ hours after the addition of rennet is dependent on the following factors :—

(1) The time at which the starter is added.

(2) The initial acidity of the milk.

(3) The vitality of the starter.

(4) The district and the season of the year.

Whether a small amount of starter is added some considerable time before the vat is set (for example, $\frac{3}{4}$% with a 1 hour prime) or a larger amount is added a short while before setting (for example, 2% with a 15 min. prime) is probably a matter of personal preference under normal circumstances. However, it should be remembered that while the starter

is in the vat it is exposed to phage infection and that the longer the time between the addition of starter and the setting of the vat, the greater is the opportunity for any phage infection to overtake starter development and cause a failure of the starter at some stage in the manufacturing process.

The higher the initial acidity of the milk the faster will be the rate of acid development, and thus a smaller quantity of starter will be necessary Likewise, the more vigorous a starter is the less of it will be required.

The amount of starter required to produce a normal working vat sometimes varies from one district to another and the nature and extent of such variations can only be assessed by experience. Seasonal influences are rather complicated, being bound up with the nature of the feed supplied to the cows producing the milk as well as general climatic conditions.

The milk is normally cooled to 86–88° F. after pasteurisation, or if not pasteurised it is heated up to this temperature. The starter is stirred into the milk in the vats by mechanical agitators or by hand stirring with a wooden rake. The amount varies usually between $\frac{3}{4}\%$ and $2\frac{1}{2}\%$.

Addition of Colour.

If colour (annatto) is to be used, it is added after the starter and shortly before renneting. The amount used varies from $\frac{1}{2}$ to 3 oz. per 1,000 lb. of milk, according to the colour desired, which is dependent upon the market for which the cheese is being made. The annatto should be diluted with four to five times its volume of water before its addition to the milk.

Setting the Vat.

With mixed milk and vigorous starter it is not necessary to wait for a definite rise in acidity before setting. If the amount of starter required is correctly determined there should not be any need to delay the setting of the vat, as sufficient acidity should develop afterwards to allow wheying-off to take place in the normal time.

The temperature of the milk at renneting is usually 86° F., but it may vary according to seasonal factors, acidity of the milk and so on.

Provided the milk is normal sufficient rennet should be added to have the vat set ready for cutting in 25–35 minutes from the time of adding the rennet. Generally 4–5 oz. per 1,000 lb. of milk is sufficient. The amount required is dependent on the strength of the rennet, the temperature, the acidity and the nature of the milk.

The addition of a higher quantity of rennet in an endeavour to obtain a firm clot with soft curd milk can cause a weak, sticky body, bitterness and off-flavours in the cheese, defects which are accentuated by a high curing temperature.

Before being added to the milk, the rennet should be diluted with 30–40 times its volume of pure cold rain water. The diluted rennet should then be evenly distributed over the whole vat of milk and be well stirred in for two or three minutes. The rakes or agitators are then removed from the vat. Over-stirring at this stage will prevent the formation of a compact clot, thus causing increased fat and casein losses.

Cutting the Curd.

The object of cutting the curd (Plate 11) is to allow the whey to escape. The smaller the pieces of curd are cut, the faster is the escape of whey.

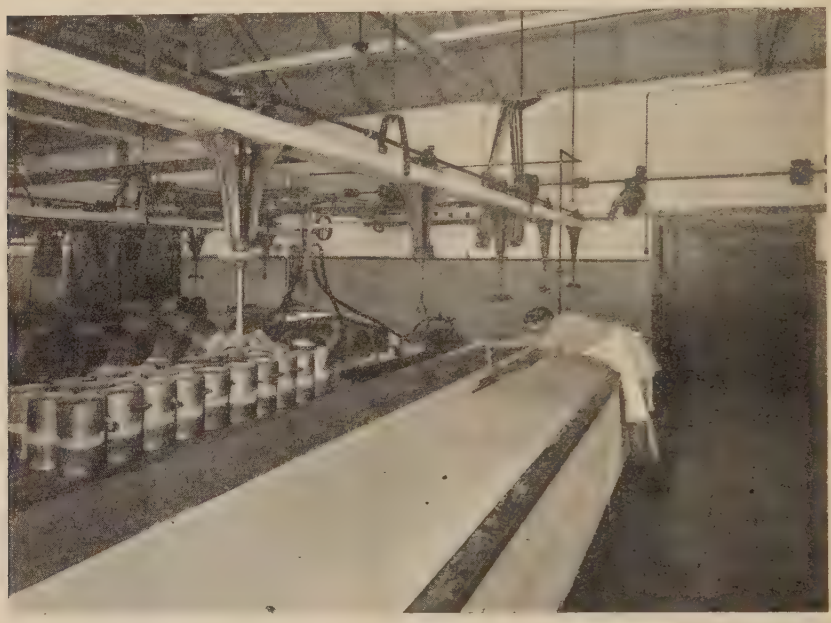


Plate 11.

Cutting the Curd. The milk has set and the curd is being cut crossways by the vertical, wide, wire curd knife.

Whether or not the curd is ready for cutting is determined by :—

(1) Inserting the index finger obliquely into the curd and raising it to the surface ; if the curd splits cleanly over the finger and leaves a clear whey, the curd is ready for cutting.

(2) Applying gentle pressure with the back of the hand and fingers on the surface of the curd close to the side of the vat ; if the curd leaves the sides of the vat cleanly it is ready for cutting.

Specially constructed knives are used to cut the curd. These are of two types—(*a*) blade, and (*b*) wire.

(*a*) *Blade Knives.*—Two knives are used, one with vertical blades and one with horizontal blades. The general practice is to use the horizontal knife first, inserting it in the vat by placing the upper end of the knife on the edge of the vat. The knife is then swung into the curd, the edges of the blades cutting into the curd and taking a circular course till the knife has assumed a vertical position parallel with the end of the vat. When this knife is drawn through the curd lengthways, it cuts the curd into layers ; but care must be taken not to jam or bruise the curd, thereby increasing losses in the whey.

The knife is turned through 180 degrees at the end of each run, so that the curd is cut and not broken during turning. To remove the knife, reverse the procedure used in inserting it.

The vertical knife is then inserted, the vat of curd cut lengthways and the knife removed. The vat is then cut crossways with the vertical knife. The knife blades are spaced to give cubes of 5/16 in. or $\frac{3}{8}$ in. sides. Care should be taken to see that the curd is cut evenly so that the resultant cubes are of even size. This ensures an even rise of acidity and an even curd colour.

(*b*) *Wire Knives.*—In recent years most factories have changed over to wide wire curd knives. The technique in using them is as follows. Both knives are inserted in the one end of the vat and two operatives cut the vat lengthways: the knives are then reversed and the lengthways cut repeated. The vat is then cut crossways, using the vertical knife. This type of curd knife permits of a quicker and more even cut.

It is interesting to note that investigations by research workers in New Zealand made it fairly certain that fat and casein losses in whey are higher when wire knives are used than when blade knives are employed.

Immediately after cutting, any curd adhering to the sides and bottom of the vat should be freed by the hands.

Following cutting, whey begins to appear between the pieces of curd and at this stage the curd should be handled gently until a film has formed around each particle. The curd is stirred by hand for 5 minutes after cutting and prevented from sticking to the sides of the vat and collecting in the corners. The rakes or mechanical agitators can then be placed in the vat.

When cutting is completed, an acidity test should be taken. In normal working vats the acidity will have dropped 0·05% to 0·07%. This is due to the incorporation of the casein in the curd particles.

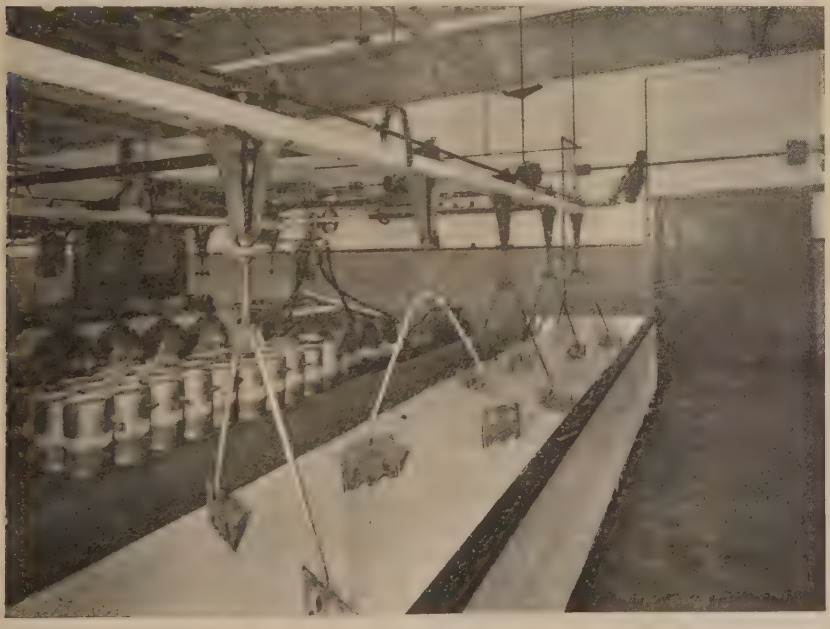


Plate 12.

Cooking the Curd. The curd and whey are being mechanically stirred while steam heating is being applied to the jacket of the vat.

Cooking the Curd.

The heating of the curd (Plate 12) is now commenced. It is carried out slowly at first in order to prevent the hardening of the film on the surface of the curd particles, which would cause difficulty in the expulsion of the whey. The rate of cooking varies according to the rate of acid development, but in a normal working vat the curd is heated up to 92° F., at the rate of 1° every 4 minutes, and after that the rate of heating is increased to 2° F. in every 3 minutes. The vat is heated to 98–102° F. in from 35 to 40 minutes.

Milk containing a high percentage of fat must be heated to a higher temperature than milk with a low fat content. This is due to the fact tha, milk with a high fat percentage contains more fat in proportion to caseint and takes more firming than a low-fat milk. The object of the heating and stirring of the curd is to firm up and dry out the curd particles. If the vat is not constantly stirred during cooking, the curd will tend to mat together and cook unevenly.

The curd is stirred and maintained at the cooking temperature until the desired acidity for wheying-off is attained. It is very important in connection with the body of the cheese that the curd be given sufficient time in the whey to develop the characteristics of a well-cooked curd.

Removal of the Whey.

This is the most critical stage in cheesemaking. The acidity, moisture content and firmness of the curd should be in the correct relationship at wheying-off; in a normal vat this should take place in $2\frac{1}{4}$ to $2\frac{1}{2}$ hours from the time of renneting. By this time, due to the action of both heat and acid development, the following characteristics should be noticeable :—

(1) The curd particles should have shrunk to about half their original size.

(2) The curd should be firm and rubbery, so that when a handful is squeezed the particles will spring apart after they are released.

(3) When the hand is moved through the whey, the curd particles should feel distinctly hard.

(4) The acidity will vary from ·14 to ·18%, depending on the type of starter used, the fat content, seasonal conditions, etc.

The greatest importance should be attached to the acidity at wheying-off, as the subsequent quality of the cheese is more dependent upon the correct acidity development at this stage than upon any other single factor in the process.

Considerable experience is necessary to decide the exact moment for the whey to be finally removed. Excess acid at this stage may result in a weak, pasty-bodied cheese, of dull colour and having an over-acid and possibly bitter flavour. Insufficient acid development tends to make a curdy-bodied cheese with a fermented or fruity flavour. The actual wheying-off point is influenced not only by the amount of acid present, but also by the rate of development of the acid. If the rate of acid development is rapid, a lower wheying-off acidity is desirable, whereas in a slow-working vat acid development should be encouraged by wheying-off at a higher acid percentage.

The whey is removed as rapidly as possible, and to facilitate its removal the curd is carefully pushed back from the vat tap to the upper half of the vat (Plate 13). A strainer is fitted to the tap of the vat to collect any curd particles which may escape. To enable the last of the whey to drain away freely, the tap end of the vat is fitted with legs which may be lowered and so tip the vat.

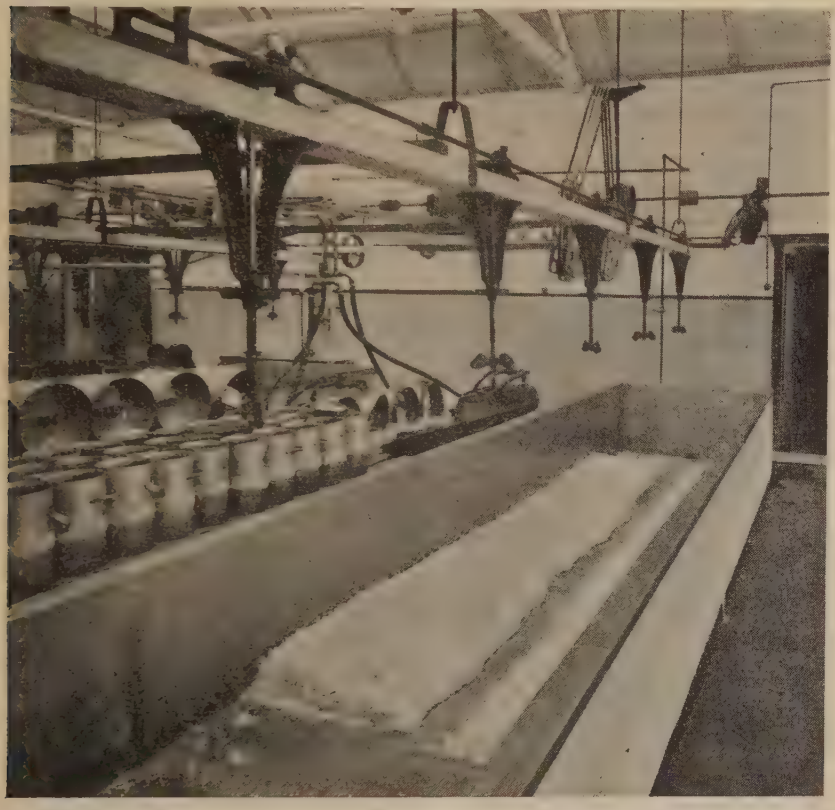


Plate 13.

Draining the Whey. The whey has been run off and the curd is about to be trimmed into two piles prior to cutting into blocks.

The whey passes through the strainer to a metal tray or steel-lined trough, from where it is either ejected or pumped direct to the whey tank.

While the whey is being drained, the curd is periodically hand-stirred to prevent it from matting and to facilitate the escape of the whey. Hand stirring at this stage is of great assistance in firming up and drying out a soft curd, but over-stirring should be avoided.

If the curd is allowed to mat before it is properly drained the excess whey may cause the cheese to become too acid.

When the vat is wheyed off, the term " dry " is applied to the existing curd condition. During the drying process a rapid rise in acidity takes place due to a reduced quantity of whey being present in the vat to dilute the acid formed within the curd particles.

Cheddaring the Curd.

The objects of cheddaring are :—

(1) The control of the moisture content by regulating the removal of the whey.

(2) The formation of a characteristic body and texture in the curd.

After the final hand stirring the curd is spread out evenly in a layer (6–8 in. deep) on each side of the vat with a channel through the middle for the drainage of the escaping whey (Plate 14). The exact depth of the heap of curd depends on its condition. The firmer and drier it is, the deeper it may be and the less stirring it will need. On the other hand, when the curd is inclined to be soft, it should be stirred more thoroughly and not heaped so high.

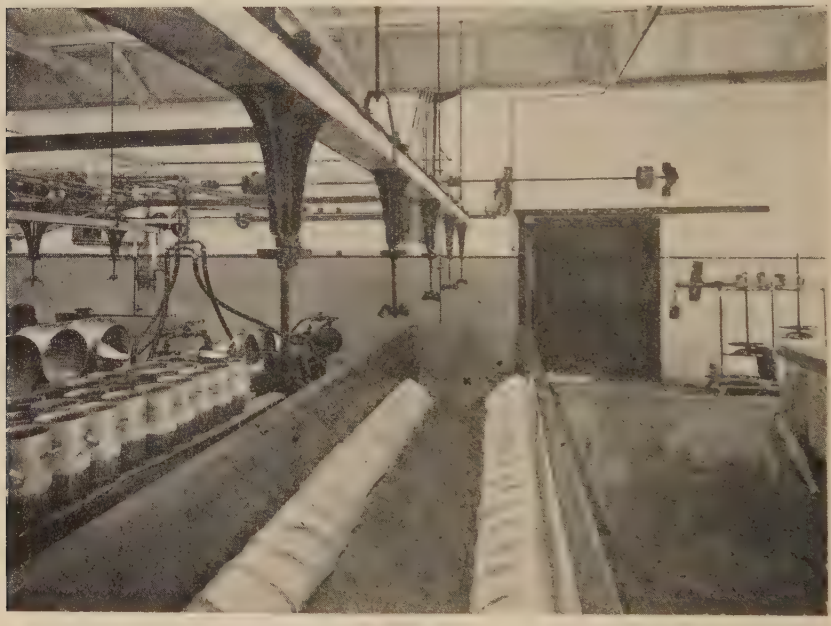


Plate 14.

An Early Stage in Cheddaring the Curd. The two piles of curd have been cut into blocks which are turned at intervals.

The inside edge of each layer is trimmed off with a knife and spread evenly over the top. After 5–10 minutes, when the curd will have matted together, it is cut into blocks about 6–8 in. wide. These blocks are turned regularly and reversed end for end with each turn. All small curd particles should be swept up from the sides and bottom of the vat and added to the piled curd.

An acidity test is taken at drying to indicate how the acid is developing. It will vary from ·20 to 25%. Normally the rise of acidity between cutting of the curd and drying should be 0·06 to 0·10%. With a normal, firm curd, the curd blocks are turned every 15 minutes and may be piled two or three deep, depending on the acidity, firmness and moisture content of

the curd. Larger blocks and deep and rapid piling retain moisture and encourage acid development. Smaller blocks, shallow piling or non-piling and more frequent turning dry out the curd and check acid development. Piling and turning are continued until the curd is ready for milling. If the curd is over-acid and soft, it is not advisable to pile it at all. A gassy curd should be cheddared longer than normally to suppress gas formation.

The cheddaring is completed when the curd is mellow and can be torn into long strings without breaking. The whey from the curd at this stage should show an acidity test of ·65–·70%. The cheddaring period occupies about 1½ to 2 hours, during which time, in cold weather, the vat should be kept covered to maintain a temperature of about 94–96° F. When cheddared, the curd is cut into pieces of convenient size to go into the hopper of the curd mill and the milling proceeded with.

Milling.

Milling (Plate 15) consists of slicing or cutting the curd into pieces several inches long and about half an inch square.

The objects of milling are :—

(1) To facilitate the escape of whey from the curd.

(2) To enable the salt to be evenly distributed in the curd.

(3) To help release undesirable odours and gases.

(4) To cut the curd into a convenient size for filling into the cheese moulds or hoops.

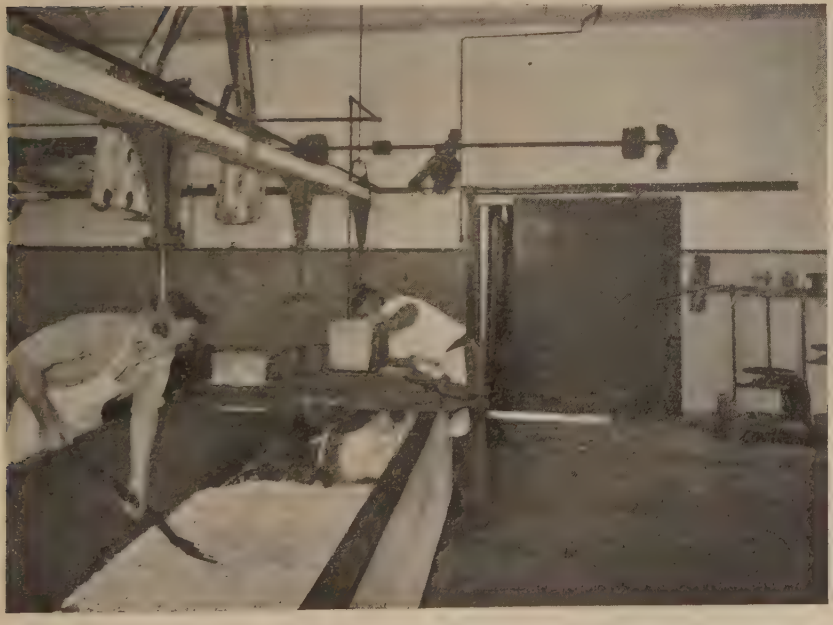


Plate 15.

Milling the Curd. The curd blocks are passed through an electric mill which cuts them into small pieces resembling potato chips.

The mill, whether operated by hand or power, should cut the curd into pieces of uniform size and should do so without bruising the curd. If a power curd mill is used, care should be taken not to run the mill too rapidly, otherwise an uneven cut will result and the texture of the cheese will be affected.

Following milling, the curd is piled along the two sides of the vat and slowly stirred and re-stirred every 10 minutes to prevent matting. The tendency to mat will cease as soon as the cut pieces form a new film. Stirring cools and aerates the curd and allows gases and odours to escape. The curd is ready for salting in 30–45 min. after milling, and it should then have a soft velvety feel. Salting too soon after milling may cause excessive fat losses, and a harsh-bodied, open-textured cheese.

Salting.

Salt is added to the cheese to improve its flavour. It also assists in further expulsion of whey, hardens the curd, and checks undesirable fermentation. The amount of salt to use depends on—

(1) The composition of the milk.

(2) The moisture content of the curd.

(3) The acidity of the curd.

Plate 16.

Salting the Curd. As the salt is sprinkled on the curd it is mixed in with a metal fork.

A rather coarse salt of good quality should be used. It is added at the rate of 2½–3½ lb. per 100 gallons of milk to give a percentage of 1·5 to 1·75 in the finished cheese. A soft, moist curd should be salted more heavily than a firm, dry curd. A richer milk will require more salting per 100 gallons than a low fat content milk to ensure the same salt percentage in the cheese derived therefrom. The acidity just prior to salting varies from

0·75 to ·95%. The salt is spread evenly over the surface of the curd in two applications, stirring in well after each application (Plate 16). The curd should now be at 80–85° F. The curd, which will feel rough after salting, is then allowed to lie for 10 minutes, again stirred and left to lie for 10–15 min. until it has mellowed. It is then ready for hooping.

Hooping.

At this stage the curd should be very firm, and when squeezed in the hand, should offer considerable resistance and spring back like rubber. The rimless telescopic type of cheese mould is used in Queensland and gives a well-finished rimless cheese. These moulds are prepared in the following manner :—The bottom lid is laid on the cheese-press or on a table, and the expanding band is forced into it. A circular piece of hessian, the diameter of which is slightly less than that of the lid, is placed inside the lid. Another piece of hessian, or preferably special outer cheese bandage, about 4 in. wider than the depth of the mould and as long as the circumference of the mould, is draped around the inside of the expanding band, with an overhang of about 2 in. at the top and bottom. The inner cheese bandage, which is tubular in form, is fixed on the inside of this, spreading equally around the bottom and the top. A circle of stiff muslin is placed on the bottom on the inside ; the outer metal cylinder is fitted over the top of the bandage and held in position by two clips. The curd is weighed into the hoops by means of stainless or tinned-steel containers, exactly the same amount of curd being placed into each hoop. Care is taken to press the curd well into the hoop, particularly round the sides. Finally, the top lid is put on, and the hoop is ready to put into the press. The temperature at hooping should be 80–85° F.

Pressing.

The main object of pressing curd (Plate 17) is to obtain a cheese convenient for handling and to present a definite, characteristic shape for market.

After filling, the hoops are placed in the press and medium pressure applied for 15 minutes, after which more pressure may be applied. After $\frac{1}{2}$–$\frac{3}{4}$ hour's pressing, the moulds are removed from the press and the curd dressed in the following manner :—The top lid is removed, then the outer cylinder, and the edge of the cheese is trimmed off with a knife. A dampened muslin circle is placed over the end of the cheese and the cheese bandage is pulled over it, being neatly trimmed to leave an overlap of a little more than an inch. The outer bandage or hessian is pulled over, a hessian circle is placed on and the lid is then replaced. The hoops are again put into the press, and full pressure applied. About $\frac{1}{2}$–1 gallon of very hot water is then poured over each hoop to aid in the formation of a rind on the cheese. The hoops remain in the press for about 18 hours for the smaller-sized local market cheeses, and about 42 hours for the 80 lb. export size.

With modern high-pressure hydraulic presses, the pressing time can be considerably reduced.

After the cheese have been pressed they are removed from the moulds and the outer bandages and the hessian circles are stripped off. Following a wiping with a clean cloth they are stamped with the date, vat number and brand. They are then removed to the curing room, where they are turned daily for two weeks and then every two days for the remainder of the time. Turning the cheese allows uniform drying out and preserves the shape of the cheese.

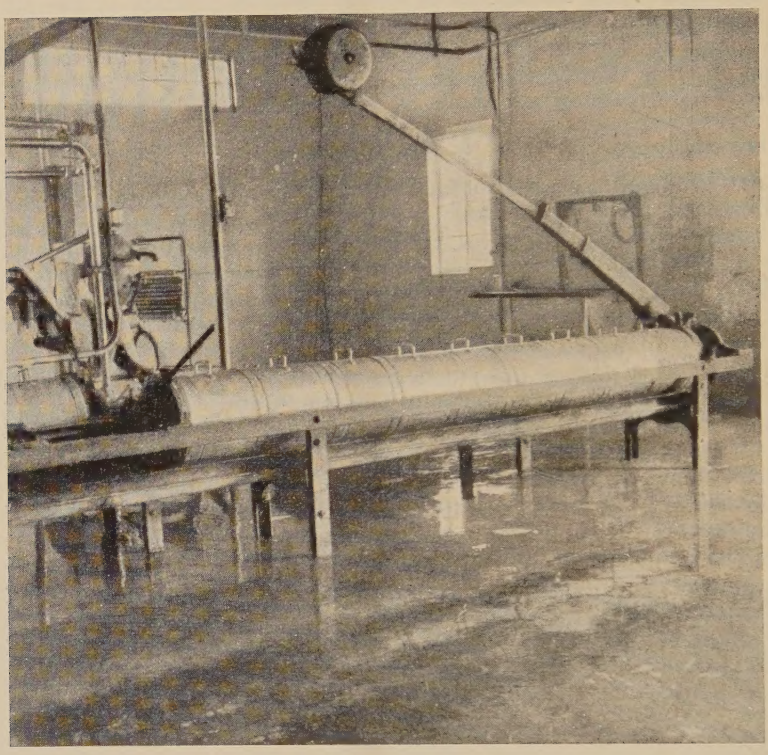


Plate 17.

Hooped Cheese in Press. The export-size cheese hoops are in a ball-and-lever type cheese press.

Waxing.

The waxing of cheese has the following advantages :—

(1) It reduces the evaporation of moisture and the shrinkage loss.

(2) It tends to prevent cracked rinds.

(3) It retards the growth of moulds on the cheese surface.

(4) It protects the cheese during transportation and handling.

(5) It reduces fat loss by sweating.

(6) It minimises the risk of deterioration from cheese mites, cheese fly and other pests.

Most waxing preparations consist of a mixture of paraffin wax and beeswax but certain proprietary lines are now available, including very good finely crystalline waxes.

Following pressing it is advisable for the cheese to receive at least a 3-day pre-drying period prior to waxing. Waxed cheese should be held in rooms in which the temperature and humidity are adequately controlled.

CHEESE MANUFACTURING RECORD.

FACTORY.

Date.	Vat No.	Weight of Milk.	Starter in Milk.			Setting.				Cutting.		Cooking.			Wheying-Off.	
			Name.	Time.	Amount.	Time.	Temp.	Acidity.	Oz. Rennet.	Time.	Acidity.	On.	Temp.	Off.	Time.	Acidity.

Drying.			Time Set-Dry.	Milling.		Salting.			Time Dry-Salt.	Hooping.		Remarks.	Milk Test.		Yield.
Stirs.	Time.	Acidity.		Time.	Acidity.	Time.	Amount.	Acidity.		Time.	Temp.		Fat.	Casein.	

As stated, waxing reduces shrinkage losses, an important economic item in the cheese industry. Shrinkage may be defined as the loss of weight resulting from evaporation of moisture from cheese. Queensland figures reveal waxing as saving a 9% shrinkage loss in 6-months' old cheese and 4% in cheese two months old (80 lb. export size).

Manufacturing Records.

The daily recording of manufacturing data is essential if proper control of cheese manufacture is to be exercised. Such data will permit the cheesemaker to adjust or modify his procedure in order to produce cheese of uniformly good quality. It will aid in deciding the remedial measures necessary should any defects appear in the cheese. Whilst it may not be practicable for the cheesemaker to keep a complete record of all the vats manufactured, every effort should be made to see that the more important particulars relative to acid development, operation times and temperatures are registered in the Cheese Manufacturing Record Book.

An example of a satisfactory type of "Cheese Manufacturing Record Sheet" is given.

[TO BE CONTINUED.]

COMMON NAMES OF GRASSES.

The following are the standard common names recently adopted or confirmed by agricultural authorities throughout Australia for some native and introduced grasses found in Queensland. The names are taken from "Standardized Plant Names," Bulletin No. 272 of the Commonwealth Scientific and Industrial Research Organization.

Botanical Name.	Standard Common Name.
Cymbopogon refractus	Barb-wire grass
Cynodon dactylon	Couch
Cynodon incompletus	Blue couch
Dactyloctenium aegyptium	Coast button grass
Dactyloctenium radulans	Button grass
Dichanthium annulatum	Sheda grass
Dichanthium fecundum	Curly blue grass
Dichanthium sericeum	Queensland blue grass
Digitaria adscendens	Summer grass
Digitaria didactyla	Queensland blue couch
Digitaria sanguinalis	Summer grass
Echinochloa colonum	Awnless barnyard grass
Echinochloa crus-galli	Barnyard grass
Echinochloa crus-galli var. frumentacea	Japanese millet
Eleusine indica	Crowsfoot grass
Heteropogon contortus	Bunch spear grass; black spear grass
Heteropogon triticeus	Giant spear grass
Hyparrhenia filipendula	Tambookie grass
Iseilema macratherum	Bull Flinders grass
Iseilema membranaceum	Small Flinders grass
Iseilema vaginiflorum	Red Flinders grass
Leersia hexandra	Swamp rice grass
Leptochloa decipiens	Slender cane grass
Leptochloa digitata	Umbrella cane grass
Lolium multiflorum	Italian ryegrass
Lolium perenne	Perennial ryegrass
Lolium rigidum	Wimmera ryegrass
Melinis minutiflora	Molasses grass
Neurachne alopecuroides	Foxtail mulga grass
Neurachne mitchelliana	Mulga grass
Oryza australiensis	Australian rice